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AUTOMATING PROJECT MANAGEMENT WITH RPA

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MASTER'S THESIS | ABSTRACT

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AUTOMATING PROJECT MANAGEMENT WITH RPA

The present Master's thesis was commissioned by an engineering consulting office, which produces most of its services in projects, mainly in digital form. Today, technology that has been developed for decades enables companies to automate this digital work by using robotic process automation.

The goal of this Master's thesis is to explore how robotic process automation can be used as a tool for project management. The study focuses on how to support this and on how to measure the benefits.

Unstructured interviews, a survey and a case study were chosen as the methodologies to carry out the study. The interviews and the survey were used to gather the data. The case study was used to study a software robot, its functionalities and performance.

Studying the operational handbook of the Company, two key processes, which describe most of the phases and steps of project management in the Company, were identified. The Interviews and the survey focused on determining the processes and tasks that are done with computers. Altogether, thirteen processes or tasks were identified. The survey was also used to explore the average completion times of some tasks. A robot was built as a case study. It was built to retrieve data from one report and transfer the selected data to another report. The performance times of the robot were measured along with the performance times of a reference group performing the same task manually.

The case study indicates that a robot is performing 10 to 20 times faster on test tasks than a human. The advantage of the robot against a human will increase as the number of transactions increases. The calculation indicates that if there is a low number of transactions in a single process, the investment decision is not easily justified. However, the situation can be changed to be favorable for the robot, if the transactions of several processes are evaluated at the same time, and the costs are shared between the processes. In conclusion, the study argues that robotic process automation can be used as a tool in project management in the Company. However, this requires that several processes are automated at the same time.

KEYWORDS:

Project management, robotic process automation, process, software automation

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PROJEKTIHALLINNAN AUTOMATISOINTI RPA:LLA

Tämän opinnäytetyön toimeksiantaja on insinööripalveluja tuottava konsulttitoimisto, jonka palveluista pääosa tuotetaan projekteissa, lähes kokonaan digitaalisessa muodossa. Vuosikymmeniä kehittynyt teknologia mahdollistaa tänä päivänä tämän digitaalisen työn automatisoinnin ohjelmistorobotiikalla.

Opinnäytetyön tavoitteena oli selvittää, kuinka ohjelmistorobotiikkaa voitaisiin käyttää projektihallinnan työkaluna. Tämän tueksi työssä tarkasteltiin myös mitä hyötyjä ohjelmistorobotiikasta on sekä miten näitä hyötyjä voidaan mitata.

Työn toteutuksen menetelmiksi valikoituivat vapaamuotoinen haastattelu, kysely sekä käytännön tutkimus. Haastatteluja ja kyselyä käytettiin tiedonhankinnan menetelminä. Käytännön tutkimuksella tutkittiin ohjelmistorobottia. Tarkoituksena oli kerätä tietoa ohjelmistorobotin ominaisuuksista sekä sen toiminnasta.

Yrityksen toiminnan käsikirjaa tutkimalla löytyi kaksi avainprosessia, jotka kuvaavat pääosin projektin hallinnan vaiheet ja askeleet. Haastatteluissa sekä kyselyssä keskityttiin löytämään prosesseja ja tehtäviä, joita tehdään tietokoneella. Näitä löytyi kaiken kaikkiaan 13 kappaletta. Kyselyssä pyrittiin vielä lisäksi selvittämään näiden tehtävien keskimääräisä suoritusaikoja. Käytännön tutkimuksena rakennettiin yksi robotti, jonka tehtävä oli hakea dataa yhdestä raportista ja siirtää vain halutut tiedot toiseen raporttiin. Robotin sekä vertailuryhmän suoritusajat mitattiin. Vertailuryhmä suoritti saman tehtävän manuaalisesti.

Käytännön tutkimus osoitti, että robotti suoriutuu helposti kokeen mukaisista tehtävistä kymmenestä kahteenkymmeneen kertaa nopeammin kuin ihminen. Robotin etu ihmiseen kasvaa sitä suuremmaksi mitä enemmän yksittäisiä tapahtumia se suorittaa. Laskelma osoitti, että jos yksittäisen prosessin tapahtumia on vähän, niin investointi päätöstä ei pysty helposti perustelemaan. Tilanne muuttuu kuitenkin ohjelmistorobotin kannalta edulliseksi, jos tarkastellaan samaan aikaan useamman prosessin tapahtumamääriä sekä jaetaan robotin kustannukset näille prosesseille. Johtopäätöksenä tämä työ esittää, että ohjelmistorobotiikkaa voi käyttää projektin hallinnan työkaluna toimeksiantajayrityksessä, mutta useampi prosessi tulisi automatisoida samalla kertaa.

ASIASANAT:

Projektinhallinta, ohjelmistorobotiikka, prosessi, ohjelmistoautomaatio

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LIST OF ABBREVIATIONS (OR) SYMBOLS

AI	Artificial Intelligence
AMA	American management association
APMBoK	Association for Project Management Body of Knowledge
ERP	Enterprise resource planning
FTE	Full-time equivalent
ICB	Individual competence baseline
IPMA	International project management association
IRPA AI	Institute for Robotic Process Automation & Artificial Intelligence
ISO	International organization of standardization
IT	Information technology
KPI	Key performance indicator
OCR	Optical character recognition
PDCA	Plan - Do - Check - Analyze/Act
PIPS	Performance Information Procurement System
PM	Project manager
PMBOK	Project management body of knowledge
PMI	Project management institute
ROI	Return on Investment
RPA	Robotic Process Automation
UI	User interface

1 INTRODUCTION

Computer sciences and information technology have grown in the past few decades so much that it has had some kind of effect in the lives of most people. Today people own computers, mobile phones, gaming consoles and even have cars equipped with computers. However, even if they do not own or use any of those in their personal lives, there is an increased possibility that computers are used in their daily work.

Previously, before computers became mainstream, data were stored by writing and typing on a paper, and everything was calculated either by hand or, for example, with the help of calculators. In the “computer era”, most of such data related tasks have been transferred to be performed with the help of computers. This is because, in some specific tasks and functions, computers have a superior capability compared to humans. It has been a significant change compared to how work was arranged before. In many cases, it has had a positive effect on productivity, quality and costs of work. It has created new industries and put old ones to extinction.

Although some things have been positive, there have also been some side effects, which could be categorized as unfavorable. With the ability to handle more data, we have also been able to create more data. As the capabilities of IT systems and the number of functionalities have increased, the complexities of the systems have increased as well. The consequence of this transformation is that people are handling more and more data in systems that are becoming increasingly complex. It gets harder to handle the data and systems. Technology is evolving rapidly, and software are updated. What was new and shiny once, is old and rusty in a shorter time than ever before.

Furthermore, businesses are also growing, and products are developed. Things are happening and changing around us all the time, also in our workplaces. It is hard already, and it is getting harder to keep up with the technologies and changes around us. It is also tempting to run with the technology wave without understanding what is going on or considering the implications of it. The caveat is that it is not hard to find ourselves in a situation at the workplace, where the processes and tasks are sub-optimally designed and executed, and we are focusing only on having data handled instead of creating actual value.

The company that commissioned this study is an engineering consulting office, and essentially a project house. Most of the work is done in projects. The Company's business is in creating value for its customers by executing projects better than its competitors and by providing services beyond the project scope. The Company seeks to be a reliable partner in business with competent and passionate workforce. However, no one can rely on just being liked in today's business world, and constant development is needed in every area of business. If it is not about reducing costs, it is about increasing efficiency or quality or something else that is relevant for being and continuing in the business and being able to create value for customers.

In project management, a major part of the value is in agreed deliverables. Besides the agreed deliverables, there are also other tasks in the project that are required to be done. Even though they also have their value, it is lesser than that of the actual project deliverables. Examples of such tasks could be timely reporting, project journaling, minutes of meetings, and many other tasks that can be categorized as *knowledge work* done by computers. In the context of succeeding in projects, such tasks, done correctly, are still relevant. Nevertheless, as necessary as they are, they are easily organized and executed in a way that seems to be spending time and resources more than what they are worth. In other words, valuable time and resources that could be used to create better value for the project are spent on these tasks.

1.1 Topic of this study

In the recent past, the Company has put a high-value tag on digitalization. It is seen as an enabler for better engineering and project delivery, as well as a strategic development area. The Company has development projects to create smarter and more intelligent systems with the aim that they will also benefit the customers.

Several years ago, Robotic Process Automation, RPA, was tried and tested in an operational project with promising results. Since the first trial, a robot has been taken into use as a reporting tool together with the customer. Feedback from that tool has been good, and the Company is looking for finding more use for the technology.

Because the Company is a project house, project management seemed to be a natural discipline to start with. However, it was not known how RPA could be used in the context of project management. This thesis will try to answer that exact question:

1. How can RPA be used in project management?

However, knowing how RPA can be used does not yet tell whether it is beneficial or not. A tool taken into use can potentially create more costs than what it is worth. It is as important to understand the potential of the tool as it is to be able to measure if the potential is reached. For this, supporting questions are needed:

2. What are the benefits of RPA?
3. How can the benefits be measured?

Answering these questions will aid the Company in deciding whether the RPA could or should be used in project management. Potentially, answers to these questions may have relevance for the future studies of either of the fields, as preliminary search for the subjects did not reveal anything that would link project management and RPA to each other. We know that the potential and benefits have been tried and tested and shown in other types of businesses, which typically have a lot of knowledge work and a large number of transactions, such as banking and insurance. (Lacity et al. 2017. Aquirre & Rodriquez, 2017)

1.2 Exclusions

The term Robotic Process Automation can easily, and mistakenly, be interpreted to include automation of physical or chemical processes with physical robots. However, in this case, we are not talking about physical robots. Physical robots are excluded from the scope of the present study. In addition, all processes that are not in direct relation to project management within the Company and do not involve *“Knowledge Work*”, are excluded.

There are many vendors of RPA technology. The selection of a vendor is not part of the scope of this study. Vendor selection is excluded and the review of a robot and its functionalities is limited to one specific vendor, UiPath, only.

Several references used in this thesis have suggested that process optimization plays a major role in the successful implementation of RPA. They suggest that the processes should be optimized before implementation and not for the sake of RPA, but for not to make sub-optimal decisions regarding the processes and ways of working. Process optimization is excluded from this study except for the applicable parts needed to understand the concept. (Gadre et al. 2017, Jaynes, H. & Livingstone, L. 2015)

1.3 Research plan

The main purpose of this study was to explore how RPA can be used in project management. Project management is a very specific discipline, with a few properties of its own. On the one hand, we have reasonably standardized project management methodologies. They are different from each other, but each of them gives a proper way to execute project management in a project for which the methodology is suitable for. On the other hand, the methodologies do not give exact instructions on how project management should be executed in practical, real-life situations. This leads to a situation where, when comparing the project management processes of two similar companies that use the same methodology, it would probably reveal similar-looking processes. However, those processes would not be the same in terms of inputs, execution and results, to name a few. Furthermore, this would be true in most processes between different companies, because it is the very nature of a business process to be heavily influenced by the environment, people and systems around it, which results in that each process is naturally unique.

Because the processes are unique for the Company and all of them are not included, in detail, in the handbook, the plan was to map out project management processes. Main processes are easily found in the quality handbooks or similar documents, but they often lack detailed processes. That was also the case with the Company.

More information was planned to be obtained with casual interviews of selected people. Several candidates were selected for the interviews. They all had in common that they had a good understanding about the Company’s way of working within projects, but at the same time, they had very different backgrounds working in the Company.

In order to get more information about the processes and the ways of working, a survey was sent to people working in project teams as project managers or as members of the team. The intention was to identify more tasks and processes suitable for RPA as well as to map out how long time those tasks and processes take.

1.4 Literature review

One of the purposes of the literature review is to gain an understanding about the topic in terms of what has been researched before and if there is something that has not been touched before. This literature review was done around the two frameworks, Robotic Process Automation and Project Management, to understand better what is out there and what has been done in research, which includes both topics. Another important aspect of the literature review is to identify proper methodologies that can, could and should be used to gather data for the research. (Hart 1999, 27-28)

For students, the university provides access to FINNA, which is an online portal and combined search engine for the Finnish public libraries and international e-libraries. Another search engine, Google Scholar, is also recommended and, therefore, also used for this literature review.

The search engines mentioned above were used and the results were partly crosschecked from both of them. Two main concepts were kept in mind and at the center of the literature search:

- Project management
- Robotic process automation

Additional concepts that relate to the goals and main concepts were searched and used. These concepts were considered to be supportive and thus not evaluated as profoundly as main concepts in this literature review:

- Process, business process
- Return on investment
- Measuring performance

Robotic Process Automation

Using only the term “robotic process automation” resulted in a large number of hits. However, most of them were not about RPA, but rather about industrial robotics, mechanical robots. The results were narrowed by using additional search words, such as “RPA”. Also, for relevancy, the following filters were used:

- Published 2010 or after
- Peer reviewed

For robotic process automation, most cited and productive authors were, according to search results of Google Scholar, Leslie Willcocks, Mary Lacity and Andrew Craig. Other authors worth mentioning are Armin Heinzl, Martin Bichler, Wil van der Aalst, Isaac Tucker and Sorin Anagnoste. There are others, but a major part of the articles found in Finna and Google Scholar, were written by these researchers.

Several books have been written by Willcocks and Lacity. “Service automation robots and future of work” was a book that was cited the most out of the books that were found.

To understand the research field, several peer-reviewed articles were reviewed from all of the authors of the list above. The relevancy, concurrency and usability were determined based on the abstracts of the articles.

In conjunction with this, also vendor and supplier articles and white papers were examined. Using Google search, suppliers were identified, and their papers were found. Suppliers produce articles, white papers and blogs, with an alternating level of quality and bias for their own products. All of these were considered when articles were used as references.

Project Management

A similar method was used with the term “Project management” as was applied for RPA in the previous chapter. The results indicate that project management is a very mature discipline compared to RPA. There are hundreds of books available, even from the recent few years. In addition to books, tens of thousands of peer-reviewed articles are available.

The sheer amount of literature makes it hard to determine the leading authors and the most concurrent material. Because of this, a more straightforward approach was selected. The methodologies within the project management discipline are very well defined and there are several standards and bodies of knowledge available. These standards and bodies of knowledge describe project management methodologies in such a detailed level that they are a good source of information for research.

1.5 Methodologies

Methodologies are part of the research. One effective method to help in determining and deciding the proper methodologies to use is to review the works of others. (Hart 1999, 28)

Qualitative research methods were used in most of the articles which discuss RPA. Methodologies used vary considerably, but interviews were used frequently in many of them.

According to Taylor et al. (2016), qualitative research applies a phenomenological perspective to produce descriptive data from spoken and written words and observed behavior. This research methodology applies for this study as it aims to explore which processes and tasks are described and used for project management.

As a method for collecting data and information, the unstructured interview method was chosen. Taylor et al. (2016) describe this method as in-depth interviewing as it aims to understand the interviewees' perspectives, experiences and situations in their own words.

Later during the study, a survey was carried out to collect additional data and information.

1.6 Structure of this study

The study starts by describing two separate frameworks, Robotic Process Automation and Project management, which will give context and foundation for the evaluation part of the findings. Supporting questions are addressed within the theoretical framework at appropriate places.

After establishing the theoretical framework, a case study is conducted, and information is gathered from the handbooks of the Company, personnel interviews and by conducting a survey. The collected data are evaluated at the end of each applicable section.

After gathering the data, a single case of a software robot is reviewed. A descriptive summary about the functionalities of the software robot started the section. One of the processes found in the interviews is used as a reference for the case. The robot and the test case is described, and the actual robot is modeled and built. Test runs are conducted with the robot, and performance figures are measured. A reference group data is collected by doing the same task manually. Finally, the results are reviewed and analyzed.

2 ROBOTIC PROCESS AUTOMATION

Robotic process automation, RPA, is an umbrella term that collects applications and services under one definition.

> *Any capability (software and services) that allows you to transact in any IT application or website, typically in the same way a human would, to automate complex, rule-based work. In other words, RPA software allows developers to tailor complex automation to a company's processes. When an RPA robot is at work, it performs tasks just like a human would: logging in, operating applications, entering data, performing complex calculations and logging out.* (Barkin 2016)

The quote is a definition of RPA by one of the leading automation service provider, Symphony. It is stating that robotic process automation is about that software, a program, is capable of doing the same interactions with other software as the human worker could. One of the most important notions of that quote is that a software robot is a software, an application that interacts with other software inside the IT system, mainly in servers or desktop computers. It also states that this one software can be programmed to perform different tasks in different systems, which is equivalent to giving instructions to a human worker on different tasks. (Barkin 2016)

The technology and industry are relatively young. However, the essential part of it, the software robot, is based on technology that has brewed for decades. Technical innovations such as workflow automation, software macros, screen scraping, optical character recognition (OCR) and image recognition together with first-generation AI are forefathers of this technology and software robots are just a natural continuum of them all. (Ostdick 2016a; 2016b)

A core function of a software robot is that it can recognize other software instances, it can read and store information from them and it can interact with functional parts of that software. An example of interaction would be that a software robot can recognize fields where user id and password would be entered, can enter those in and successfully log in to a software or service. (Kirchmer 2017) A software robot is also interacting with software in a non-disruptive way in the same interface layer as a human does. Implementing software robots does not require expensive changes to information systems. In most cases, it is not affected by interface changes that may occur because of software updates, providing that underlying software UI elements have not been changed. (Heinzl et al. 2018, Galusha, B. 2018)

As the term Robotic Process Automation suggests, it is a technology developed to automate business processes. A process is essentially a description of a system, where one or multiple inputs initiate a set of actions resulting in specific outcomes for those inputs. (Makadam et al. 2019)

Process that is usable by a software robot is usually more detailed that a process designed for human use. In its basic form, without any AI functionalities, a software robot is only capable of doing what it has been instructed to do. It is not capable of reasoning or determining correct results from insufficient data similarly as people can. For this reason, the process described for software robot is and needs to be inclusive, including all required steps and functions and it cannot leave anything out, which can affect the result. A major reason for this is the difference in cognitive reasoning between a software robot and a person. (Lacity et al. 2016; 2017)

Software robot, on its own, is not usually enough to have a successful robotic automation experience. A set of developer tools and a robot controller are also a fundamental part of the system. Developer tools are used to set up the environment and robots, as a software robot cannot do anything by itself. It needs detailed step-by-step instructions to do anything. Regarding this, an industrial robot is very similar. It also needs programming before it can perform any tasks. And when the programming is done, developer tools are not needed to run the process anymore. (Lowes 2016)

The controller, on the other hand, is very similar to a software robot. The difference is that it is designed to act as a manager for the robotic workforce. It controls processes, workflows, information, roles and robots. It can assign single or multiple robots to a task and give them access roles and credentials. As software robots can also act alone, the controller is not needed in every case, but the benefits become more evident when the number of software robots increase. (Lowes 2016)

2.1 Market and service providers

Le Clair et al. (2018) have identified 32 RPA product vendors in their report about Robotic Process Automation. From these 32 vendors, they included 15 most significant vendors, that met criteria listed in Table 1 below, and evaluated those vendors against 30 different attributes. Evaluation resulted in a map of market leaders, strong performers, contenders and challengers.

Table 1. Criteria to include vendor for evaluation. (Le Clair et al. 2018)

Each vendor has a product orientation rather than a service orientation.
These providers have strong breadth of RPA functionality.
Each vendor markets actively in at least two major regions.
Vendors meet the minimum revenue requirements.
Each vendor has significant market share or is an innovator developing new capabilities.
These providers generate strong customer interest.

All of these vendors provide enterprise-ready solutions, from which each company can choose the one that suits best for their needs. The market leaders, according to the report, are UiPath, Automation Anywhere and Blue Prism. The report also states that vendors that did not appear on the list may very well provide a suitable system that meets the needs.

Table 2. 15 most significant RPA providers. (Le Clair et al. 2019)

Vendor	Product evaluated	Product version evaluated
Another Monday	AM Ensemble	N/A
AntWorks	ANTstein	SQUARE
Automation Anywhere	Automation Anywhere Enterprise (AAE)	A2019
Blue Prism	Blue Prism; Thoughtonomy Virtual Workforce — Evolution Edition	v.6.5; Edition R3
EdgeVerve	AssistEdge	18.0
Intellibot	INTELLIBOT	v2.0
Kofax	Kofax RPA	v10.6
Kryon	Kryon Automation Suite: Intelligent RPA and Process Discovery	19.3
NICE	NEVA	v7.1
Pegasystems	Pega Robotic Process Automation	Pega Robotic Process Automation 19.1; Pega Robot Manager 8.2.2
SAP	SAP Intelligent Robotic Process Automation	N/A
Servicetrace	XceleratorOne	2/5/2000
Softomotive	WinAutomation and ProcessRobot	WinAutomation v9; ProcessRobot v2019.1
UiPath	UiPath RPA Platform	v2019.4.4
WorkFusion	Intelligent Automation Cloud	10.0

In the updated report, Q4 2019, evaluation criteria have been reduced to 25. Table 2 lists the vendors included in the 2019, Q4 report. (Le Clair et al. 2019)

2.2 Benefits of using software robot

In business, it is common to evaluate investments together with possible gain received from it. Investment is good if gain is positive, and bad if gain is negative. This concept is known as *Return on Investment, ROI*. In simplest, it is the ratio of money received and money spent. Sometimes gains (or benefits) are not directly translatable to monetary value. Then it is a business decision to give value, for any gain perceived, to evaluate if the costs are justified. Return On Investment is a useful way to showcase the benefits of the investments (IRPA AI 2018).

Many case studies and articles have indicated that RPA can produce quite substantial ROI in very beneficial use cases. These cases have been in industries that rely on heavy use of IT systems and have a large amount of single transactions, such as banking and insurance. (Lacity et al. 2017. Aquirre & Rodriquez, 2017)

Institute for Robotic Process Automation & Artificial Intelligence (IRPA AI), article ‘Understanding RPA ROI’ (IRPA AI 2018) lists three major categories for benefits:

- Improved efficiency
- Customer experience
- Increased innovation

In many tasks, a robot is simply more efficient than a human. In addition to just pure efficiency, properly implemented RPA solution will have several other outcomes that will translate to improved efficiency at the end. It is not only about that the robot itself is faster than a person. If processes are appropriately optimized, it will also increase productivity and utilize resources more efficiently. (Kapulukira, 2019)

Another clear benefit, when compared robot to a human, is quality. Human workers are prone to make mistakes. In general, a working robot is not. Because software robot is a software, executing given instructions, it is not capable of making mistakes. The robot will do exactly what it has been programmed to do, over and over again and does not deviate from that at any point. However, that does not mean that mistakes cannot happen with software robots, they can and when they do, it can be a big one. However, those mistakes are usually traceable to human actions. As long as the design and programming are properly done, a robot will reduce the number of errors to zero and improve quality.

Quality improvements are, in most cases, seen beneficial, but the actual benefits might not be seen directly or immediately. At times, it can be challenging to originate reduced costs of insufficient quality back to RPA and that increased quality is a result of RPA implementation. Implications of improved quality are also hard to pinpoint accurately. However, it will likely increase quality, and thus also customer experience is improved. Furthermore, it might increase sales and even lead to new customers. (IRPA AI 2018)

Other benefits, such as increased innovations, are harder to see and be realized. Nevertheless, it is likely, that successful implementations of RPA will allow human workers to focus on value instead of menial and repetitive manual tasks. (IRPA AI 2018)

Above we established that it is beneficial to be able to showcase ROI. However, ROI cannot be calculated without proper data. One needs to understand the costs as well as benefits, as the ROI is expressed as a percentage or ratio of these two.

$$ROI = \frac{\text{Current Value of Investment} - \text{Cost of Investment}}{\text{Cost of Investment}}$$

Equation 1. Return On Investment

Costs of investments include two types of costs. Implementation cost is everything needed to implement RPA solution. Recurring cost is everything that comes after the implementation. Together these are the cost of the investment. On the other side, we have the current value of the investment. It is everything that is gained from the RPA solution. Some of each type has been included in Table 3. (IRPA AI 2018)

Table 3. Costs and benefits of RPA. (IRPA AI 2018)

IMPLEMENTATION COST	RECURRING COST	CURRENT VALUE
Initial tool cost	Licensing fees	Reduced costs
Consultancy	Consultancy	Improved efficiency
Employee fees	Employee fees	Increased profitability
Implementation	Maintenance	Enhanced quality
Proof of concept	Support	Increased customer satisfaction
Design	Re-design	Improved performance
Training	Training	Scalability

Costs are relatively easy to get an estimate on this equation. Each of these costs can be locked with a scenario that will suit the needs for presenting ROI in different stages of implementation and the RPA life cycle. (IRPA AI 2018)

Current value, however, is more complicated. It is important to understand what are the benefits and how they can be measured. One concept used to help with the evaluation is Full-Time Equivalent, FTE. (Alberth & Mattern. 2017) In this concept, the FTE is the cost of a person to do a specific task or a process. For example, process A has 4 persons that work on the process 50% of their work time. That equals to 2 FTE. Cost of 1 FTE is the annual salary for one person working on the process, 50 000€ per year in this example. The annual cost for process A is 100 000€, equals to 2 FTE.

Process B is the same process, but it is optimized for RPA. In this process, there is still one person working on the process for full time and additionally, there are two new persons to maintain the process for 25% of their work time. This equals to 1.5 FTE. FTE for process B may be different because of the salaries of the persons working may be different than in process A. In this example, we use the same value, 50 000€, as in process A. Process B annual cost is 75 000€.

The value gained for process B is how much less it costs compared to process A. It is 25 000€ in this example. It is a combination of improved efficiency, improved performance and reduced costs. ROI of the investment would be positive if the annual costs of the RPA would be less than 25 000 €.

The above example does not consider all possible factors that should be included. For example, other benefits have value, which was not included. For FTE costs, only annual salary was used, but other costs can be included here also, provided that they are fixed to the number of persons. One thing to notice is that as salaries are already included in the FTE, they cannot be included in the ROI calculation for a second time as costs anymore.

2.3 Measuring performance

The concept of measuring performance implies within itself that attributes that are measured are compared against something comparable, measurements of equal quantity and quality. For example, a car engine has a measured power of 95kW. That has little value to anyone without more context. Having a baseline, history data of previous revisions that same engine during development, gives something to compare to. The value of that measured power increases significantly. One is capable of evaluating if the development is going forward in terms of engine power. Knowing the rated powers of similar engines from other manufacturers yet increases the value. One now has an opportunity to evaluate where they stand against competitors. Without such baselines or comparable values, it is difficult to evaluate the effects of any changes made in anything.

To measure the performance of a robot, one needs to determine what are important performance indicators. This may change with each robot solution, because each solution may be naturally unique and the benefits will realize themselves differently.

One example of measuring robot performance is from a case study. In that study, it was determined that important performance indicators were:

- Number of agents (persons)
- Mean case duration
- Total number of cases
- Cases per agent (person)

Selected performance indicators measure efficiency and productivity. Baseline for the case was created with a group performing the same task manually without RPA. (Aquirre & Rodriquez, 2017)

The above indicators are decent indicators to start with. Something that anyone can easily understand and measure. But for each case, these indicators should be considered separately. For example, depending on the case, some other indirect indicators may be useful and can be measured. An example of an indirect indicator would be the number of claims before and after implementation. However, caution is advised with indirect indicators, as their relevancy to the results may not be correct and may be caused by something else.

With the indicators, it is also important to create the baseline or comparable measurement. Just knowing that we have 300 cases with a mean time of 8 minutes does not give us any meaningful information without the baseline and or, for example, targets. In the example case, measured indicators of the group without RPA, set the baseline to compare against. Our above values, 300 cases and 8 minutes meantime, have a lot more meaning, if the comparable baseline for the same time frame, is 200 cases with a mean time of 15 minutes. With these, we can now estimate efficiency increase or cost reduction, for example. Again, caution should be taken with the baseline and especially when sample amounts are low. A low amount of data samples may be misleading and could contain a significant amount of error in it, resulting in a false interpretation of the data. Sometimes, history data is not available, and the baseline cannot be established accurately. In such cases, the baseline could be estimated as accurately as possible. Another option, instead of establishing a baseline, is to set targets. With adequately set targets, one can compare the current state against the targets and thus evaluate the need to change something.

3 PROJECT MANAGEMENT

”A project is a temporary endeavor undertaken to create a unique product, service or result” is a definition of a project from ’A Guide to the Project Management Body Of Knowledge”. (PMBOK GUIDE, 2013). The PMBOK Guide, published by Project Management Institute, PMI, defines shortly and simply what a project is all about. It implies a few characteristic attributes of a project.

1. Project has a start and an end
2. Project is temporary
3. The outcome of a project is unique

The temporary nature of the project means that the project will always be initiated by someone or something. It is not a continuous process, where products are delivered one after another. It will also have an end, a set of conditions that will dissolve the project and project team. Such conditions could be, for example, that the product has been created or a client will decide to terminate the project. (PMBOK GUIDE, 2013)

Temporary does not define the duration. A small and simple project may last a week as where a large and complex project can take over ten years to finish. Similarly, it does not define the life span of the outcome. For example, in construction projects, it is expected that a building would last for decades after the project has been finished. (PMBOK GUIDE, 2013)

Uniqueness of project outcomes, product, service or result, does not mean there cannot be similarities in them. Construction projects may often have the same design for a building, but they can still be two projects independent of each other based on, for example, team, time and place or some other circumstance that will be unique for each project. When outcomes are created with ongoing work, repetitively, even when the results may have unique properties, it is not considered to be a project, but rather a repetitive process that follows existing procedures. (PMBOK GUIDE, 2013)

There are several types of projects. Some examples of projects are listed below.

- Developing a new product, service or result
- Effecting a change in the structure, processes, staffing, or style of an organization

- Developing or acquiring a new or modified information system (hardware or software)
- Conducting a research effort whose outcome will be aptly recorded
- Constructing a building, industrial plant, or infrastructure
- Implementing, improving, or enhancing existing business processes and procedures
(PMBOK GUIDE, 2013)

3.1 General project management

Project management is a discipline involving all that is needed to manage projects to achieve desired results.

“Project management is the application of knowledge, skills, tools and techniques to project activities to meet the project requirements.” This PMI’s definition of project management singles out four categories that a project manager needs to master to be a successful project manager, PM. When projects grow larger and more complex, the amount of information, planning, decision making and controlling activities grows with it so much that proper methodologies, processes and tools are needed. Fortunately, those are very helpful in small and simple projects too. (Dinsmore and Cabanis-brewin 2014)

Project management is sometimes, as a misconception, reduced to only scheduling and using software to manage time and resources. Those are merely tools that aid project managers to do such activities more precisely, easier and faster and, as a result, give project managers more time to focus on other activities. Essentially, project management is much more. AMA Handbook of Project Management lists ten knowledge areas that are needed in the successful management of projects.

- Integration management
- Scope management
- Time management
- Cost management
- Quality management
- Human resource management
- Risk management
- Procurement management
- Stakeholder management

Together these ten key areas compile into the whole of project management. Processes defining these areas create the methodology that is followed and run when the project is executed. (Dinsmore and Cabanis-Brewin 2014)

Quite many methodologies have been developed during the relatively short history of project management. A literature research made by Rivera and Kashiwagi (2016) identified twelve project management methodologies in the industry. Methodology was accepted as project management methodology if it was a management model created to improve the delivery of services and it was commonly known and used. Those twelve methodologies are

- Waterfall Methodology
- Rapid Application Development
- Agile Methods
- Scrum
- Prince2
- Lean Management
- Deming PDCA
- Business Process Modeling
- Spiral
- Stage Gate
- Best Value PIPS
- PMBOK

Several of these methodologies have been created because a need for a better project performance has been identified. Some of them have similar elements as some others, such as waterfall and gate or agile and scrum and few of them are quite different such as lean or best value PIPS. All of these have been developed as an attempt to improve project deliveries. (Rivera and Kashiwagi 2016)

Standards and bodies of knowledge

There are several standards or bodies of knowledge written. Several of these guides are widely considered to be most significant in their own geographical area. An international ISO standard has been created, but even that has not acquired the position of “the standard". Tryouts for the creation of one standard have led to the conclusion that different models will continue to coexist. (Dinsmore and Cabanis-Brewin 2014)

PMBOK Guide by PMI is one commonly known and identified as the body of knowledge. It was the first published body of knowledge for project management. First edition was written in 1987. It has since evolved throughout the years and today it has reached its sixth edition. PMBOK guide's heart is in its ten knowledge areas and their component processes, forty-seven altogether. PMBOK further defines those component processes within five process groups. These five process groups can also be identified as phases in project execution:

- Initiating
- Planning
- Executing
- Monitoring and controlling
- Closing

PMBOK Guide is a collection of generally recognized good practices. It focuses on knowledge areas, processes and practices that are usable for most projects most of the time. (Dinsmore and Cabanis-Brewin 2014)

APMBOK by The Association of Project Management Body of Knowledge is another commonly known body of knowledge. This body of knowledge has been created on a notion that PMBOK did not deliver all the knowledge that project managers needed. The main difference between the two bodies of knowledge is that PMBOK focuses on a generic process intending to deliver projects on time, in budget and to scope, and APMBoK takes into consideration a broader view and includes technological, commercial and general management issues as well as also knowledge and practices that may apply only to some specific projects. APMBOK was started at the beginning of the 1990s and has currently reached its seventh edition. The body of knowledge has been divided into four sections, context, people, delivery and interfaces, fifteen sub-sections and fifty-three components. (Dinsmore and Cabanis-Brewin 2014)

Individual Competence Baseline, ICB, by the International Project Management Association, IPMA, was first written in the late 1990s. Current, 4th version, had been published in 2015. The purpose of this baseline was to provide a reference for national standards for IPMA's member associations. It is a standard and provides a base knowledge for the skills required in project management. It includes forty-six competence elements which are divided into knowledge, personal attitudes, skills and relevant experience. Notion is that mastering these competence elements are needed to be a successful project manager. (Dinsmore and Cabanis-Brewin 2014)

3.2 Project management at the Company

The Company has standardized its project management by writing a Project Management Handbook. This handbook was written to be used as a tool to support project managers and leaders in their daily work. It is a collection of best practices proven in use. Practices and guides in this book are based standards and knowledge on ISO, PMI and IMPA methodologies.

Handbook gives background information about projects and project management, in general, and later in more detail. It describes the key processes of the Company and how project work is organized. Key processes are very general, but they lead to more refined sub-processes. The scope of this study was project management. Within the Company’s key processes, two processes, Project Management Process and Change Management process. Both of them are used in operative projects. Both include major task descriptions and some additional links to either more detailed instructions to a complex task or a document template to a deliverable. Together handbook and process descriptions will give a solid base to manage projects in the Company.

These two key processes are also excellent first tie-in point considering RPA. In a perfect system, key processes and references within them will provide all the possible information, sub-processes and tasks that could be reviewed for RPA implementation and they could be run by a robot, at least partly.

3.3 Processes and tasks

In everyday life, we do activities, which we usually describe as tasks, to achieve something that will be different than what it was before the task was initiated. In business, in our work, our day is often composed of a series of tasks. Some of those tasks may be interconnected and they belong to a set of higher-level tasks, which aims to a specific result. This set, a collection of tasks and sub-processes, is often called a business process or just a process. In this context, processes and tasks have very similar meanings and descriptions. Difference being that task can also be a single step on its own and process is always a set of at least three items, initiator, task and result. Both of them can be collections of activities that are interconnected to each other logically. They both have initial inputs, for example, results from the preceding task or process. These inputs are starting the described activities, resulting in a changed outcome.

The difference between a process and a task is that, process describes a series of sub-processes or tasks at higher levels. At the process level, the description could be, for example, “check document”. At the task level, “check document” could describe a detailed step by step instructions on how to check the document.

The main processes of the Company are too general and high-level processes that they are not good candidates for a software robot. One reason is also that they include cognitive parts and parts that are not done in a proper environment. A robot is not capable of doing the whole process and certainly not something that is done in the physical world. However, sub-processes and tasks may very well be something that can be tuned, divided or directly, at least partly, be given for a robot to handle.

Process is a concept that comes up regularly with implementing RPA. And not just because the process is in its name and its very definition. Several sources and studies lift the idea that in order to have a proper implementation of RPA, the processes need to be well thought and tuned. Not because of implementing RPA, but because optimizing processes before implementation usually has positive benefits in a similar manner than RPA would have.

For software robots, we need to have very detailed and specific descriptions for each step of the process. According to Lacity et al. (2017), when implementing a software robot, the process is usually needed to be optimized for full benefits. Process, which is designed for humans, can be sub-optimal when done with a robot and even impossible to implement as such. A properly optimized process, can be done by a human, but is also directly and relatively easy to transfer to a robot. It is also possible that part of the process may still need human interaction. While the process is robot-driven, it can contain sub-processes or tasks that are still performed by human. Figure 1 illustrates such an example of a process before and after optimization. When optimized for a robot, these interactions shall be considered. Some tasks can be found obsolete, new may be created and the sequence of tasks execution can be changed.

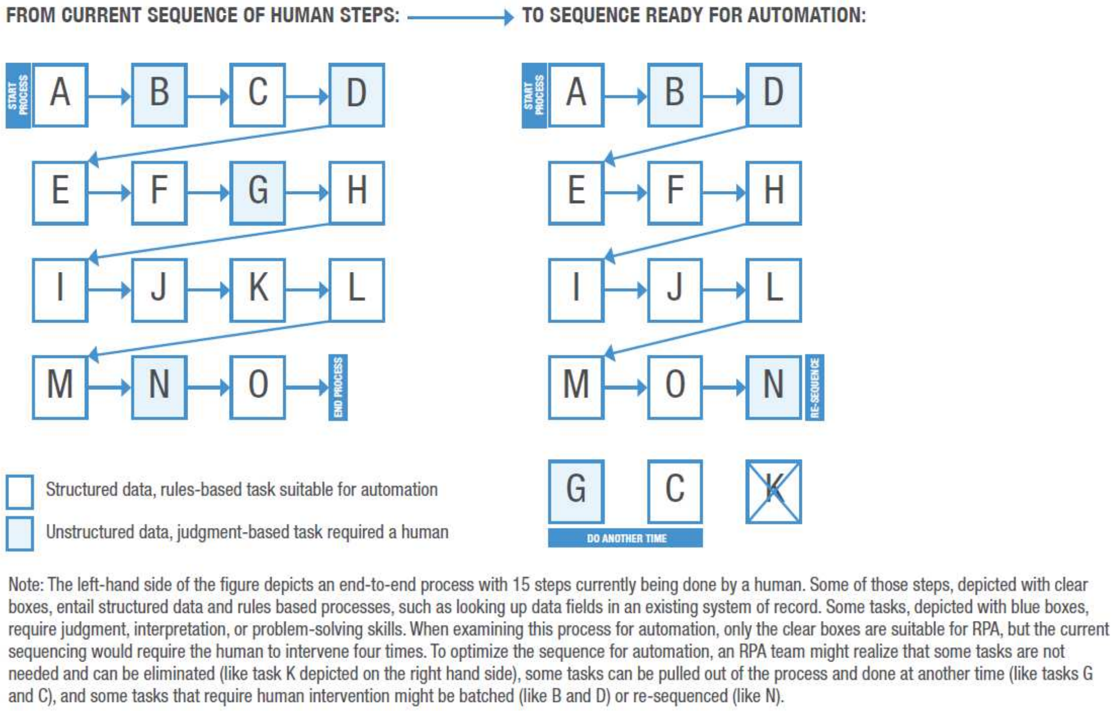


Figure 1. Example of process optimization. (Lacity et al. 2017)

3.4 KPI and metrics

Key performance indicator, KPI, is often used together with business processes. The main purpose of KPI is to serve easy and reliable access to the current status and performance of the process. They can also be used to forecast future status and performance, to some extent, with properly designed forecasting models. They are often used to alarm process responsible people if the process is going in the wrong direction and thus helping them to take actions to remove or mitigate the effects, sometimes even before the event even occurs.

The key performance indicator is something that is current and relevant to the actual process. For each process, each KPI is determined based on the process itself and based on what is wanted to be shown or indicated. For example, in a transaction process, the number of sub-processes or tasks finalized at a specific period of time, would be a very relevant KPI. There are usually several indicators for each process measured. Proper consideration of KPI also includes the way data is collected. It is suggestible that actions taken to collect data do not increase workload significantly for any person. An optimal solution would be a fully automated collection. (Anagnoste 2018, Kerzner 2015)

There are many methods to measure or collect data and also to show and visualize it. The optimal way would be fully automated collection, which is done during the process execution, inside the software used during the process execution. Visualization of the KPI’s would also be automated or built in the software used. At times, when full automation is not possible, it may be required to include the data collection as a step in the process to achieve proper integrity and quality of the data. One such case would be to replace swivel chair action, where data is collected from many sources into a single output file or vice versa, with RPA. (Kerzner 2015)

The selection of KPI’s is dependent on the process, but also what has been agreed to be measured or followed. For each process, there may be a large number of measurable or recordable points or data, but using all of them as KPI’s is neither beneficial nor efficient. The use of KPI should be limited to relevance and desired outcome. For example, a process could have five KPI’s that are monitored regularly, cost per unit, transactions per day, lead time, number of rejects and downtime. The first three would be standard KPI’s that are regularly monitored for the process at any time. The last two, however, would relate to the development of the process. While the data may have been available from the beginning, those two KPI’s have not been monitored but added only after it was decided to have some relevant KPI’s to monitor how development is improving the process. Later those two may be permanent KPI’s, but in this case, they would be temporary and not monitored after the development has been finalized. KPI’s can and should be added or changed when it is needed and it would improve the relevance of it to the process. (Anagnoste 2018, Kerzner 2015)

Relevance of the KPI’s also means that they are not needed in every process. This is especially true for sub-processes. They are part of a larger set and the KPI’s in the whole may cover the subprocess entirely. The same may apply to small processes with only a few steps. The action and process itself may be insignificant compared to the whole and it is chosen not to measure it. (Kerzner 2015)

4 CASE STUDY: THE COMPANY PROCESSES

To answer the questions established in the beginning, a frame needs to established. In this case, it is the commissioner, the Company and its Project management discipline. The Company describes it is core business in several business processes, which are called key processes and support processes. Two of the key processes mentioned earlier, the project management process and the change management process are directly governing what is done within project management.

These main processes are high level in a way that many of the tasks or steps are not fully described and thus are sub-processes. These sub-processes are not described in a way that they could be used for RPA and for that, more information is needed. This missing information seemed to be partly silent. Thus interviews and survey methods were used to collect more information about the processes and tasks that are explicitly done using computers.

Another reason for information gathering is the possible benefits of RPA. Many of the benefits of RPA relate to cost reductions by means of improved efficiency and productivity. For that reason, in both the interviews and the survey, questions were made about how much time different activities take.

4.1 Project management handbook at the Company

The Company's operational handbook covers project delivery and includes two key processes related to operative projects, process management process and change management process.

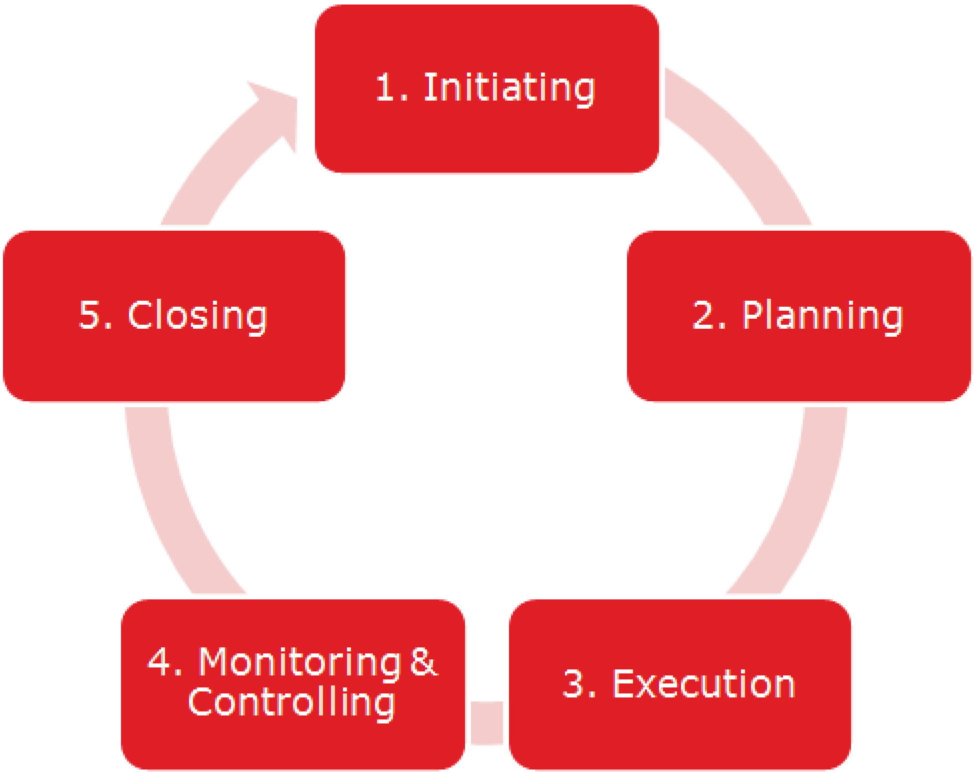


Figure 2. Project management project phases (the Company 2019)

The Company's project management follows a very common project management process groups. These five groups are named in Figure 2, which is describing project phases and their relation in a general and simplified view. The Company's process management process describes the main flow of the process. Additionally, it has written descriptions for major steps and also gives main documentation, data management and deliverables within the project. (The Company 2019)

The change management process is described similarly as the project management process. But compared to the project management process, it is simpler and more streamlined. The amount of documentation, data management and deliverables are also less.

4.2 Interviews

Because company processes were not fully described on the task level, it was clear that an effort was needed to find out what is done with computers in the Company's operative projects. Therefore, interviews were selected as an information gathering method because of the nature of the information, which was mostly hidden knowledge and not written in any guides, handbooks or instructions.

Target was to find out tasks and processes that operative project managers and members would do in their projects that would involve mainly manual information and data management with computers. These tasks and processes would then be evaluated in terms of how good fit they would be for RPA.

Four persons were interviewed from various discipline, experience and competence level. The interview itself was a casual type of discussion where the topic was guided by the interviewer towards the point of interest. Appendix 1 lists the orienting questions and guides that were used as support for the interviews to help stay in proper topics.

Interviews were recorded and transcribed. Transcriptions were condensed and partly interpreted to keep the focus on topics related to this study. In the recorded interviews, there were a lot of discussions and topics that do not serve the purpose of this study at all.

4.3 Survey

Information collected from the handbook and interviews did not give any baselines in terms of how long it takes to perform them and how people perceive them. The information, that were looked for the baseline, was about what tasks and processes people are doing and how long those tasks take on average, when they are doing operative projects. With this information, it would be possible to estimate some benefits that a robot would bring in a similar task. Additionally, how people perceive these tasks in terms of importance and mundanity, gives us some perspective on the frustration that a task might give people. A survey was conducted for the purpose of getting baseline information.

The survey was constructed so that the first two questions align the participant into the subject, which is manual work done with computers in operative projects. The following question, after that, asks participants to evaluate how much time, most time-consuming tasks take. The final question asks participants to evaluate tasks that they feel are meaningless or futile and then describe them more closely. There was a challenge to build up the questions so that they would guide the participant into the right way of thinking without already giving the answers to them. Survey questions are shown in Appendix 2.

As a last question, it was asked if the participant wanted to discuss more about the topic. Several persons gave their name and email for the purpose. An additional interview was arranged with those persons. Discussions in those were based on the questions in the survey. The interviews were recorded as well and transcribed similarly as the original interviews.

4.4 Evaluation of the data and information from interviews and survey

The interviews

The first set of interviews (four interviews conducted in 2017 and 2018) were evaluated as a one group. The second set of interviews, conducted in 2019, were evaluated and added to the list of findings, if any new findings were made.

The primary result of these interviews is a list of processes or tasks that these persons are doing with computers while they are executing operative projects in the project team as a project manager or as a member of the team. These processes or tasks found, and selected into the list, are directly related to project management. There were also discussions about processes and tasks that are not related to project management, but to the deliverables of the project. An example of such a process or task would be document delivery to the customer. It is often handled by the project team, but it is part of the delivery process and not the project management process. Also, the detailed way of working is often agreed during the project execution and, as such, is not even a stable process or task. These discussions and results were excluded completely from the scope of this study.

The most common finding from the interviews was that on the project management level, in the project team, the interviewees are mostly doing reporting related tasks, both internal and external reporting. According to the interviewees, the current way of reporting did not seem to be standardized throughout the disciplines and projects and although few of the interviewees referred to the same report, when shown, the reports were slightly different. In terms of RPA, non-standardized reporting, makes use of automation more difficult. Three different types of reports were identified and in all of those, the mechanism to fill them up was similar. They were filled up with information that was already collected and stored digitally on other locations. Time used to fill up those reports varied from tens of minutes to two hours, depending mostly on the complexity of the project.

Other notable findings were related to project scheduling, resource tasking, project initiation and document creation. All of these are done manually and can potentially save several hours per project when automated. One more worth mentioning is a task done on some product care type of task, which is handled like a project. Resources working on this project are logging hours in several systems. These hours are then checked and compared that they are the same and correct in each system. An error of half an hour in the logged hours may cause several hours of manual work to check and identify the error. A simple task that would be done within minutes if automated to a robot.

None of these processes and tasks found are recorded in the Company's handbooks properly. Within this study and interviews, they were not mapped and the processes or tasks remains mostly unknown in the details. Within the findings, it was also not clear if different people were talking about the same reports in each case. The finding is that we do manual reporting in project management that could be automated as well as some other processes and tasks that have the potential to save resources, decrease costs and improve quality.

The survey

The survey was sent to 60 people and 26 of them replied. All of the questions are shown in Appendix 2. The evaluation of the survey results is focusing on time spent in manual tasks done with computers that are closely related to reporting, data management or anything that requires manual work done from at least one system to another.

Out of the 26 people who answered, two-thirds of them work only with the computer when they work on operative projects. The majority of their tasks with the computer relates to communication, for example, emails, skype meetings and chatting with other people. About one-third of the time, time was spent on either reporting, data management or design work.

Reporting, managing data and managing files were the predefined focus categories. “Other category 1, 2 and 3” were used to find out if there were something else than predefined categories that would be considered relevant for the topic.

According to the participants, they were using 3.6 hours on average, every week, on reporting. On managing data, they were using even more time, 4,7 hours on average per week. On average, they were managing files for 1,9 hours per week. Participants reported in ‘other category 1’ that they spent 4,7 hours on average per week. There were three answers to this category and only one description was interesting considering the topic. This single answer was 2.8 hours used to manage hours from the customer system to The Company system. Figures are collected in Table 4.

Table 4. Average hours used on a task (survey question 3).

CATEGORY	AVERAGE HOURS USED
Reading and writing emails	1,14
Attending online meetings	2,05
Talking or chatting with other people. (Skype or similar)	0,88
Using design software	8,93
Initializing and creating reports	**3,63**
Managing data	**4,67**
Managing files	**1,86**
‘Other category 1’	4,67 **(2,8)**

Participants were asked which task they think is useless, unnecessary or menial to them. They could select 1 to 3 items. Out of 24 answers, 46% selected file management, 25% selected initializing and creating reports and 17% selected data management. Three participants selected ‘other category’, but none of the descriptions were interesting to this study. Table 5 lists all the categories from highest to lowest.

Table 5. Tasks that seem useless, unnecessary or menial (survey question 10).

CATEGORY	NUMBER OF SELECTIONS	PERCENT OF ALL ANSWERS
Reading and writing emails	2	8.33%
Attending online meetings	2	8,33%
Talking or chatting with other people. (Skype or similar)	0	
Using design software	3	12,5%
Initializing and creating reports	**6**	**25%**
Managing data	**4**	**16,67%**
Managing files	**11**	**45,83%**
'Other category 1'	3	12,5%

As a last question, participants were asked to describe at least one task that they thought should be automated. These answers are listed in Table 6 (irrelevant answers are left out).

The list in Table 6, agrees with the previous finding that tasks related to reporting are those that participants feel that should or could be automated. Some of the answers do not seem to be descriptions of what has been done, but merely something that participants think should be done. Those types of answers were included in the list if they belonged to project management.

Table 6. Description of tasks that participants think should be automated (survey question 21).

TASK DESCRIPTION
Project input would be available from the original document to design basis + other designer inputs, basically with one button click, instead of copy-pasting the same text in several documents.
All financial and workload -related reports should be able to produce in ERP.
Moving data, e.g., estimation info from software to other to enable resource level follow up and workload.
Comparison of reports.
Dashboard view of ongoing activities.
The status reporting of documents should be automated. The person in charge of the document has one place to fill in the status etc. Anyone who wants to know the status can request an automated report from the system.
Adding resources to ERP
Better templates for project management documentation.
Data collection and manipulation can be automated to a larger extent
Progress could be automatically filled as per hours spent and then these to be checked. In case progress is less, changelog to fill.
Reporting Project follow up based on used hours (project progress). Schedule follow-up (possible to define per task or project)
Creating reports could be simplified significantly with the right templates and database filled correctly by everybody in the team
Maybe project reporting, resourcing could be more automated in some way.
Progress as per milestones
When working on multi-discipline projects, an email or a file is read by several people and then classified and stored by all recipients (normally) several times. On important projects the corresponding time can be colossal due to the thousands of emails we receive.

5 CASE STUDY: SOFTWARE ROBOT – UIPATH

5.1 UiPath – software robot

The Company has already selected a robot and service provider, UiPath, and is using it in a few applications. Therefore, in this study, no studies are made to select a robot. However, as a general rule for any company considering RPA, it is advisable to study what requirements the company or business processes have for automation and what features different robots offer, before making the selection.

UiPath has been one of the leading provider of RPA service and robot for some time now. According to the latest The Forrester Wave report, Q4 2019, UiPath was ranked the leader on strategy and market presence, with Automation Anywhere just one step behind. Both of them scored full points on category 'Bot development/core UI/desktop functions. It is safe to say that at least the functionality and usability of the robots provided by either provider is over the top compared to many others, according to The Forrester Wave report. (Le Clair et al. 2019)

UiPath robot experience starts with the designer software, UiPath Studio. UiPath Studio is the "workshop", a software, where the robot is designed and tuned to execute desired tasks. It is the development environment for the robot. Robot itself is another program, which UiPath calls an agent that runs on a tray and background, waiting for the call to execute a process. In addition to these, there is a third software called the orchestrator, which is used to manage several robots. This would be the case when software robots are fully utilized on a larger scale and business. The fourth software that can be launched from the studio is a 'UI Explorer'. This is a support software that can be used to identify UI elements when the robot process is designed.

UiPath Studio user interface (UI) is built so that one can see, quite easily, how the robot will function. There are also many features of the Studio software that are there to help the programming and are not part of the features that are included in the robot itself. Some of those features of the studio software are techniques, such as OCR, that are used as support to program the robot as well as techniques that the robot can use while it is executing. The visual studio type of programming, dragging and dropping functional UI elements does make the design easier and one does not need to be a proficient programmer to be able to have a working robot. However, programming or designing the robot is still not that intuitive process and there is a reasonably steep learning curve before the first task is executable by the robot.

Studio software has a large library of predefined actions that are used to control the robot. The robot can be fully programmed just by using them. Although programming skills are not necessarily required, having them and understanding some functionalities better because of it, makes all the difference of what one can be doing with the robot. Studio software also has several support wizards, listed below, that help the user to program required functionalities into the robot.

Recording → records user activities and brings them into sequence. Six different types of recordings. Basic, desktop, web, image, native Citrix and computer vision.

Screen scraping → a technique used to identify text from visual information like pictures.

Data scraping → similar to screen scraping, but is used for structured data.

Several user event → monitoring keyboard, mouse, clicking on an image, clicking element, on keypress element

These are just the main features of the studio and also what techniques the robot is using to interact with software and UI during the execution. One of the main features is that the robot is capable of identifying UI elements from under the visible surface. Each UI element has, within the operating system, software windows and software instances, a unique address that the robot is capable of accessing directly. These elements then have attributes that the robot can use to extract data from or input data back in. The address of these UI elements remains the same until software UI is updated so that the UI element is not the same anymore.

Studio also has a large number of activities that one can use to control the actions of a robot. One example of these activities is opening an application. In the studio, there are several techniques one can use to set the target application. One of the easiest ways to select the target application is just to open the application one wants to open and then indicate it by first clicking the activity ‘indicate window on-screen’ and then clicking the application window.

There are three different design/execution schemas available: sequence, flowchart and state machine. A fourth, special sequence schema is also available for unhandled error situations. Sequence is step by step type of linear execution schema where all actions follow each other. Flow chart has more complex execution with parallel lines and decision nodes, for example. State machine is in many ways similar to the flowchart, except that going from action to action, the execution is in stages and changes between stages are triggered by events.

5.2 Example robot

Reporting was something that several interviewees mentioned and experienced that, as a task, would be something that could be transferred to a robot, at least partially. Based on this information and findings, a simplified, crude, example robot case was created to evaluate the benefits and procedures on creating the robot.

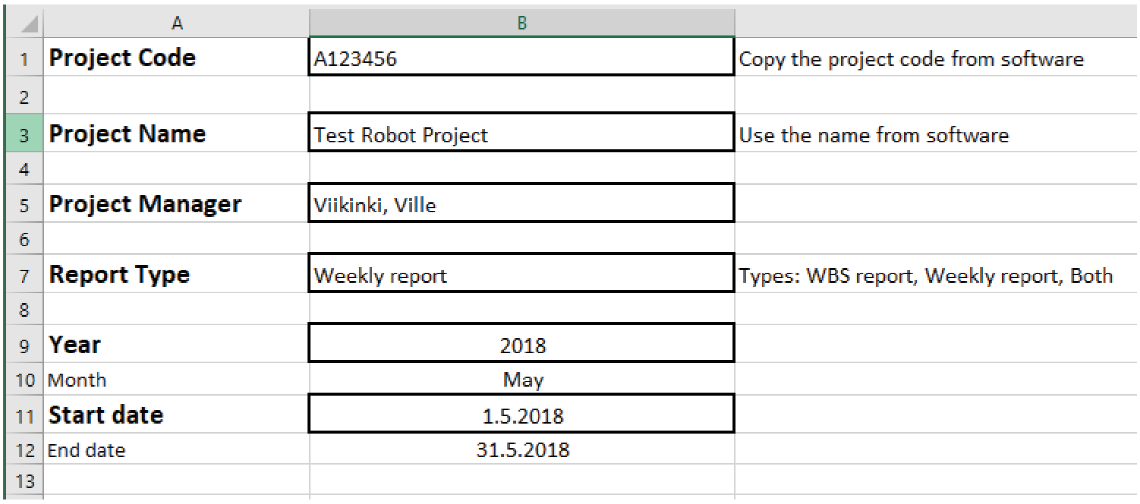
Robot was created to add data from an excel, weekly hour report from a specific month to monthly hour report excel. Usually, the data that was to be added would be in ERP software, but to reduce complexity for this case, data were prefetched and saved into several excels, which each contained monthly data from a specific project, from the first day to last day of the month. Three projects were prefetch with each with their own time period that expanded for at least five months.

Robot would select the correct project and monthly data excel, read it, parse it and write the data back to either existing monthly report, or it would create a new report from a template and store that to a predetermined place, based on given rules.

In the execution, for the actual data, the robot would use three files:

- Input data excel, a weekly hour report from ERP software
- Initial data excel, preformatted excel that the user fills with input data for each robot run.
- Monthly report template excel or already existing monthly report excel for the project

The initial data for the robot would be input from the user in an excel that is put to a specific folder for the robot to read. Figure 3 shows the input data for the robot. With the excel robot will receive project code, project name, project manager, project type, year and start date as input for the project. With this input, the robot is capable of identifying which input data excel it needs to read, check if there is an existing monthly report available or whether a new report is needed to be created. This initial data template was created along with the robot and reflects directly on how the robot is controlled in this case.



	A	B	
1	**Project Code**	A123456	Copy the project code from software
2			
3	**Project Name**	Test Robot Project	Use the name from software
4			
5	**Project Manager**	Viikinki, Ville	
6			
7	**Report Type**	Weekly report	Types: WBS report, Weekly report, Both
8			
9	**Year**	2018	
10	Month	May	
11	**Start date**	1.5.2018	
12	End date	31.5.2018	
13			

Figure 3. Initial data excel used to give inputs for robot

For the purpose of this example case, the existing monthly report template required some modifications so that the robot and the monthly report would function together correctly. This modification of the report template is a natural part of the optimization of processes that are highly recommended and needed for the successful implementation of RPA. Nature of the changes were such that they did not affect the end results of the report in any way and it looks essentially the same as without the modifications.

The input data for the robot was exported from ERP software, which is used to report project hours in. If this had been an actual RPA case, this ERP interface would have been used directly, but as it would have made the robot creation so much more complicated, it was chosen to have the input prefetched and saved to excel instead. The data was exported using existing report templates from the software and actual data in resulting excels were not modified in any way with the exceptions of a few months that were used for manual tests for comparison. For those months, some tasks were deleted from input data to reduce the amount of manually added tasks for the test.

The robot was created with UiPath Studio, version 2019.10.4. For the programming, many e-learning resources provided by the UiPath and other online resources were used. Without such resources, the example robot case would have been hard to create.

The main steps of the robot are listed below in the execution order. Figure 4 shows the flow of the main process. In addition to these main steps, for the purpose of this example, two steps, one in the beginning and one to the end was added to log the total process times in separate excel.

- Get files from initial data folder
- Assign attributes needed
- Read first (/next) task input excel
- Initialize monthly report file
- Read from input data excel
- Write monthly report excel
- Check if all initial input data excels have been read

The main process is capable of reading multiple initial data excel files in the same run. In the flowchart, decision point checks if all initial data excel files have been read. In case they have not, it returns the execution to the start of the logging and loops the steps again until all initial data excels have been read.

The main steps are mainly placeholders and most of the actual functionality of the robot is inside of those holders. A more detailed description of all steps and sub-steps is found in Appendix 3.

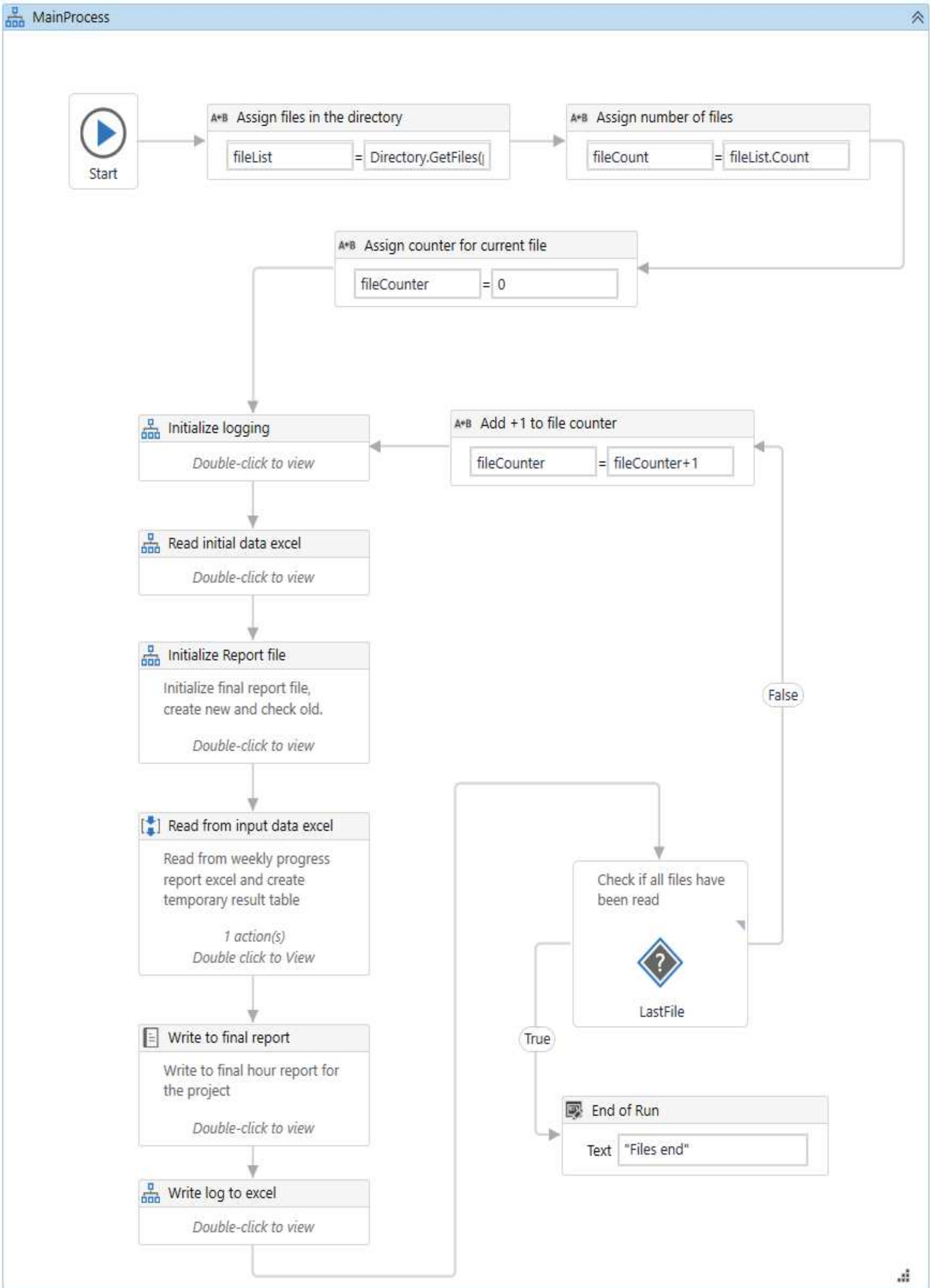


Figure 4. Main process flow of the robot (UiPath Studio Software)

Existing processes and tasks would usually be needed to optimize for the robots for at least some parts. To understand what the optimization could mean, Figure 1 shows an example of unoptimized and optimized processes side by side.

In comparison, the flowchart of the example robot, shown in Appendix 3, is created directly for the robot, so there is no existing processes or tasks to optimize. Every step is considered only for the robot and the purpose of having it to read and transfer data. A noteworthy mention about the example robot is that there is no consideration of how this robot would be used in an actual production environment and there are no additional error checking procedures added on top of those that are automatically added during the creation of the robot.

5.3 Ways to control the software robot

There are numerous ways of controlling the robot. The event initializing robot run can be designed as easily as the robot itself. It is a common way of working that initiating events are either designed into the executing robot itself or to another robot, such as the orchestrator. In the case of the orchestrator, it will monitor the events and initiate or launch executing robots based on those events. The robot could be running on the background as a continuous process or periodically check changes on given initiating events. Some default functions to start the robot run are built-in, which can also be used. The current version of robot software allows the run to be also executed by the user at their will. Example robot was run manually from the UiPath Studio software, after initial data excel was added to the proper folder.

5.4 Measuring the performance and effectiveness

The setup with the example robot is very synthetic. It only approximates real-life situations and for this case, it is not optimal in terms of how the data is collected, for example. One purpose of the example robot was to evaluate the benefits of robot implementation. In Chapter 2.2, the benefits of the robot were introduced and with this example, some of those benefits are validated. For simplicity, we are focusing on efficiency and quality and are having a separate discussion of costs were these results will be referenced.

The KPI’s for this example robot is ‘time of execution’ and ‘number of seconds per task’. ‘Number of errors’ and ‘errors per 100 tasks’ were included in manual tests. It is not included in robot logs. Errors made by the robot are non-existing, because, in essence, the robot is incapable of making errors. Errors “made” by the robot are errors in robot programming and not of the robot itself, thus essentially made by humans. While building this robot, such errors were encountered and at least one was still present in the final runs.

As mentioned before, for the purpose of evaluating metrics and change, a baseline or comparative measurements are needed. For that, three people were asked to do the same tasks manually as the robot was doing. They were given the same information as the robot was given and they were asked to log starting and ending time for each monthly addition they made to the reports. These were the baseline for the comparison of how efficient the robot is against human counterparts and what kind of cost reductions they would be in terms of labor costs. The number of ‘errors’ in the test log, relates to the quality of the human worked only, because the robot performs these tasks flawlessly. There was also a high probability that test persons would also perform without any quality mistakes, given the sample size is very small and they would focus just on this without any interruptions.

Manual comparing group test was also performed by the author to compare whether it has any significance when the person knows precisely what is needed compared to the three people who only got brief instructions before the task. All manual result logs are in Appendix 4.

Performance of the robot

Logs of the robot runs are included in Appendix 4. From that data, an anomaly can be seen in the first run, where the execution times for two last runs for ‘Example project 2’ were significantly higher than in other runs. This was visible in the times of first runs and concluded that it was a result of OneDrive automation that was active in the system. Anomaly disappeared after OneDrive synchronization was closed for the duration of the rest of the test.

Two other runs, run 10 and 11, had also higher individual execution times, which was a result of a robot setting were the monthly report excel was visible during the run. This reduces run time significantly.

Most runs were made having multiple initial data files as input; thus, each file would run in succession to previous until all files were run. Additionally, few single file runs were logged, but those did not show any significant difference in run times against multiple files.

All of the runs were done under 1 minute and with an average speed of around 1 task per second, peaking in 3,48 tasks per second. A notable finding was that in ‘example project 2’ where the task amount was significantly lower compared to other projects, the average speed was below or close to 1 task per second and significantly lower than those runs were task count was higher. This is most likely due to the fact of how the robot was constructed. There are many tasks which the robot does that are not related to reading and iterating tasks from input data or writing to report. Time to execute those will be the same regardless of how many tasks need to be written to the report. This will show in tasks per second as reduced efficiency when the task amount is low enough.

Another finding is that all comparable run times are reasonably constant with each other. There is some variance in the execution times, but those are either close to each other or easily explained with conditions in the system or weekly report task composition. With many looping possibilities, running time is somewhat vulnerable to tasks that are new to the final report. Surprisingly, creating and using the report template, first runs for ‘Example project 2’, did not seem to have any impact on running time as it did with human tests.

Performance of the test persons

In terms of tasks per second, test people did, on average, 0.11 tasks per second or about 20 seconds per task. The speed varied from 9 to 65 seconds per task. This value includes all the file actions, opening, reading, transferring data and saving. Data indicates that the first report is clearly the slowest and suggests that everyone was able to speed things up after a while when doing each month successively. The average speed drops to 15 seconds per task if we drop out the slowest speed for each person.

The quality of the work was also a focus point for the manual test part. This was represented in the excel with a number of mistakes for each added month to the reports. None of the test persons succeeded without any errors. The highest amount of errors for the whole set was 6. The highest single month error was 4 errors. All persons performed well with example project 2, which had less than 10 tasks to be added per added month.

Performance of the robot against a person

There is a clear and large performance gap between RPA and a person, as can be seen in Table 7, collected results of the tests and the resulting graph of the average speeds of the robot and all test persons, Figure 5. On average, the robot performs roughly 2 tasks per second. When compared to persons speed, it was roughly 10 to 20 times faster with a programming that was not optimized for performance.

As stated previously, the robot does not make mistakes. It does what it has been told to do. For a person, on the other hand, there were a total of 182 transactions per person. For all test persons, there were a total of 546 transactions. The number of errors found in all tests was 10, which gives us roughly 2 errors per 100 transactions. Quality-wise the robot was unmatched and superior.

However, for quality, we need to consider that this was a synthetic test and not a real-life situation. Two test persons stated that had this been a real-life situation, they would have used more time to check the results. Considering also the sample size, the only safe conclusion is that people make more mistakes than a robot.

Table 7. Results of robot and comparing group test

		AVERAGE SPEEDS, seconds/task						ERRORS	
PERSON	TOTAL TIME	1st RUN	NEW REPORT	FEW TASKS	MANY TASKS	AVERAGE 1	AVERAGE 2	Total	# / 100 tasks
Robot	01:49	1,14	1,14	1,16	0,41	0,59	0,57	0	0
Jan	56:16	19,8	45,3	22,6	16,9	18,2	17,2	3	1,6
Turo	1:04:37	25,5	65,4	20,2	21,2	21,0	19,2	6	3,2
Mikael	1:04:08	37,1	37,1	16,4	22,2	20,8	20,2	4	2,2
Satya	1:21:53	89,3	89,3	41,0	21,9	26,6	24,1	3	1,6
AVERAGE		42,9	59,3	25,1	20,5	21,6	20,2	4,0	2,2
MEDIAN		31,3	55,4	21,4	21,6	20,9	19,7	3,5	1,9

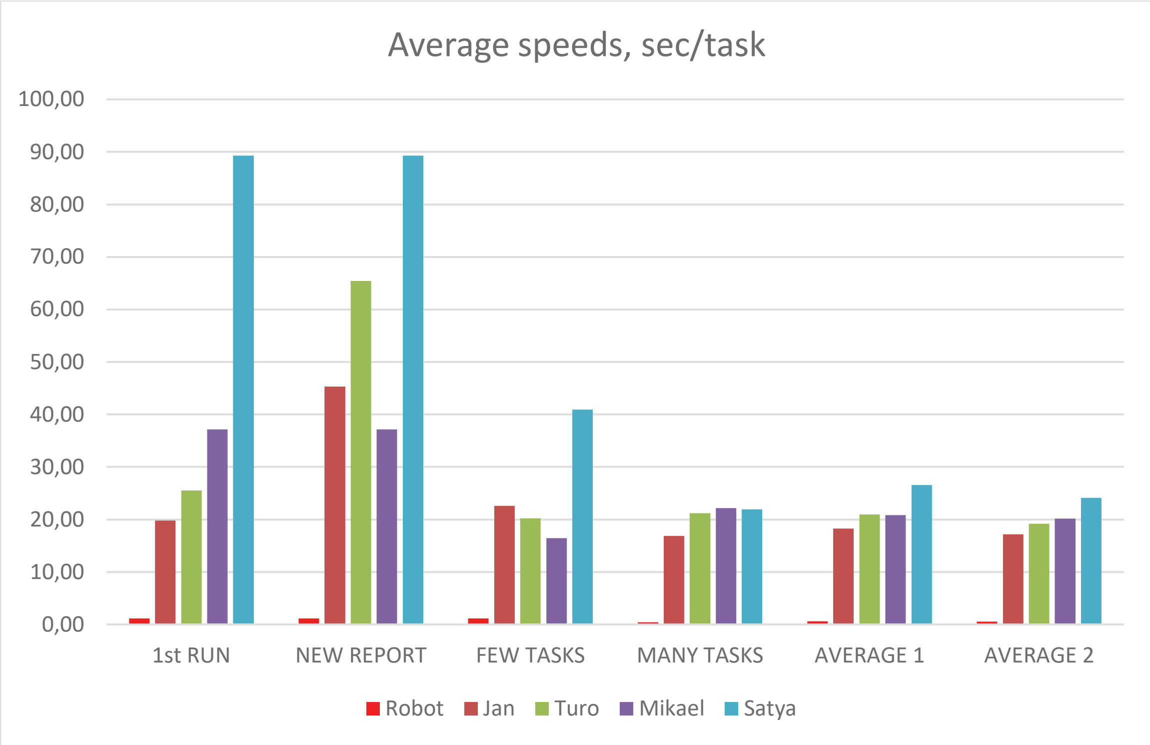


Figure 5. Average speeds of robot and comparing group, seconds/task.

The final results made by the robot was not perfect, either. However, the reason for that was not the robot itself, but how it was programmed. The logical routines programmed to the robot were somewhat complicated and hard to follow. Although several test runs were made with reduced input database size, and those came out flawlessly, the actual runs with full input database had some conditions which created unwanted results. Figure 6 highlights these unwanted results with red text. This issue did not break anything on the report, nor did it not give any false results either. All the necessary data was there, but it was found in incorrect rows and we had multiple rows with the same task name. The actual hour data was not duplicated in any rows. This was a clear programming error and not an error of the robot itself.

5 Civil	0	1 851	2 698	2 577	2 203	1 444	10 772
5.3.3 Power house						26	26
5.4.1 Power house, incl. compressor room						42	42
5.4.2 Pump house						8	8
5.4.4 Electrical buildings, MV-, Control-, GIS-						124	124
5.1 Civil design coordination		174	174	148	199		694
5.2.5 Drainage 3D re-modelling					7		7
5.4.7 Other buildings						98	98
5.5.1 Power house						226	226
5.5.2 Stack structure						31	31
5.5.6 Electrical buildings, MV-, Control-, GIS-						190	190
5.5.8 Workshop & warehouse						15	15
5.5.9 Other buildings						4	4
5.5.10 SCR and duct support structure						110	110
5.5.11 Pipe and cable bridges						6	6
5.5.12 Other structures						361	361
5.6.8 Site area						3	3
5.7.1 Power house incl. compressor room						19	19
5.7.4 Electrical buildings						143	143
5.7.7 Other buildings						40	40
5.3.3 Power house					11		11
5.3.18 Other foundations					26		26
5.4.1 Power house, incl. compressor room				24	175		199
5.4.2 Pump house				3	2		5
5.4.3 Unloading station				8	2		10
5.4.4 Electrical buildings, MV-, Control-, GIS-				123	62		184
5.4.5 Workshop & warehouse				31	11		42
5.4.6 GPRS Gas Pressure Reduction Station					7		7
5.4.7 Other buildings				76	77		153
5.4.8 Reagent tank yard				9			9
5.5.1 Power house				691	948		1 639
5.5.2 Stack structure				131	93		224
5.5.3 Pump house					10		10

Figure 6. An example of unwanted results caused by a programming error

6 CONCLUSIONS AND FUTURE OF RPA

6.1 Methodologies and reliability

This chapter is about evaluating the methodologies and reliability of the results. General evaluation is that the chosen methodologies, interviews and survey and how literature review was done are appropriately selected and proper methodologies for this thesis.

Interviews were planned as much as they could have been planned without turning it to be a structured interview. However, considering how far from the subject interviews went, it could have been planned more carefully and turned into a semi-structured interview. This would have kept the discussion more focused on the subject and the same results would have been gotten with lesser time. The selected method of interview was a proper one, but it could have been executed better.

While interviews were reviewed, it was noted that discussions were wondering outside of the scope of this thesis topic and thus, a lot of time was wasted. This wasted time could have been used to focus on, for example, to map the process and tasks in more detail. Final results could have been more focused and thus more detailed with more experienced interviewer with a better understanding of how to execute the interviews. This became evident while transcribing the interviews. It was already visible when comparing the first interviews to the last interviews, which already showed signs of being more focused.

The original plan was to interview more than four people, but there were difficulties in arranging time from the schedules and all planned interviews were not held. Considering the sample size, this was a mistake and it was tried to be corrected later with interviews after the survey. However, it turned out that the interviews after the survey did not add much to the results and they only confirmed some of the items found on the first set of interviews.

Overall, looking at the results as a whole, they are not that poor as described above. The list of findings is not long, but it does capture the essential processes and tasks that are done within operative projects by the project members that relate to project management. It is not all-inclusive, but it is covering significant parts of tasks that could be transferred to RPA, at least partly.

One of the “hidden finding” was that we do a lot of other tasks too during the execution of a project, but they do not fall under the umbrella of project management. A deliverable of a project, for example, a list of components, is a project delivery tasks rather than project management task. These tasks are maybe different in each project, but there are also similarities in them, which may create an illusion that they would belong to project management.

The reliability of the interview results is easily biased by the interviewer. In this case, some discussed topics were dismissed by defining them outside of the scope. Also, the interviews were loosely transcribed, which leaves room for interpreting what the interviewee has said, again with a bias towards what the interviewer wants to hear. Essentially, everything that has been recorded has been said, but interpretation may have changed the initial message in the results. However, the interview results have not been used in anything essential except for the example robot case. It is just a list for somebody to use if they choose to do so. The list is also specific for the Company and cannot be used as such anywhere else. Furthermore, the items in the results are very high-level items without detailed description. When used, one needs to study the item in more detail and thus confirm it is reliability.

With better execution, better experience of how to execute informal interviews, with more interviewees, the final list of findings would have been more inclusive and the information regarding those items would have been better detailed for the future purposes.

Similarly, as to interviews, for gathering specific information about the subject, a survey is a suitable method. Again, lack of experience in planning and executing a survey made it inefficient. Survey questions and structure have a greater meaning and relevance to the results than in informal interviews. The wording on the question and additional information is important in terms of how the person understands the questions and thus how a person answer to them. The additional interviews after the survey revealed that some of the questions were not that easy to understand correctly. When looking at the answers as a whole, there seems to be a change in the quality of the answers towards the end. This was probably caused by the complexity of some of the questions and partly because the person was not anymore committed to the survey and focused on answering the questions.

What was tried to accomplish with the survey was to collect data about different tasks and how long they would take to do. Answers seem to be focused on the predefined categories in all questions. In retrospect, it looks like the questions were guiding and directing the participant too much and the logic in some of the questions were too complicated and not explained adequately. Although, fear amount of data was received with the survey, mostly in predefined categories, it did not reveal any new areas or categories, which was something that was aimed at. In that sense, it might have been better if all of the questions would have been predefined items, thus making the survey less complicated.

The timing of the survey should have been different also, which would have helped with the planning of the questions and predefined items on them. The results look reliable in the context and the participants seemed to give answers with their best abilities. One change could have made the results from the survey significantly better. The survey was planned and conducted before a single interview was reviewed. With more information from the interviews could have made the planning of the survey better and thus results better for this thesis.

6.2 Project management and RPA

The original question for this thesis was: “How RPA can be used in project management?”. The short answer would be: “In the same way as it is used in any other discipline and business area.” That is true, because the same steps of implementation are reasonable in whether RPA is implemented in discipline or business which is favorable or not. The actual question that remains to be answered is whether the implementation is feasible. RPA technology can do quite a lot and it is developed all the time and it can do even more in the future. But that does not mean that it should be used nor that it would be the only option to be used. There are many ways to achieve preferred results and RPA is just one tool amongst many.

The question of “How RPA can be used in project management?” should probably change to “Where in project management it is feasible to use RPA tool?”. Project management as a practice and discipline is already mature, but it is still not standardized under one way of doing things. Furthermore, many standards and books of knowledge give a lot of room on how each company arrange the practical part of managing the projects. This leads to a situation where we have something that looks similar when looked from bird view perspective between standards, books of knowledge and companies, but when reviewing them in more detail, they are not the same. The processes and tasks are so heavily influenced by so many things that are specific and unique to each company that they cannot be considered the same even if the result is called by the same name. It is possible that the high-level names, descriptions and even number of steps are the same for some process, but when going into details, they are different because systems are different. Companies use different software, configure that software differently, use them in different ways and setups. There are so many possibilities that it may be impossible to define one solution that fits all companies.

This study does not give a clear or simple answer on how RPA can be used in project management, but it did open a door for opportunities for RPA in the Company. Some conclusions from literacy are that if there are many transactions, people are working in swivel chair tasks, tasks include a lot of manual clicking, there are opportunities. In some industries, like banking, insurance and mobile services, there may be hundreds of thousands of single transactions per month with a computer. For these kinds of cases, it is easy to determine that they are opportunities for RPA. It can be shown without any significant effort, how much less it costs to have ten robots instead of 20 human workers.

If considering cases where the number of transactions is significantly lower, the benefits are not as easily seen. Then it is required to consider multiple factors to argue the case. Literacy did not give any direct examples of low volume cases. The only reference was in an article which wrote that CEO of a company had decided that the proper limit for favorable investment decision was that cost reduction would equal or be more than the cost of three FTE’s. And that is precisely what is needed to be considered in each case. What are the decision-making limits and rules in each company for each case?

When decision-making rules are clear, it is fairly easy to estimate whether to invest in RPA or not. Considering ROI, for example, it is a simple calculation after all factors have been collected and evaluated. In the example robot case, the measured and evaluated data gives clear values of how the efficiency and cost changes. One might be able to show that the estimated cost reduction will give more than the required amount of ROI, if that would be a limit.

6.3 Making a case for RPA in Project Management

Many articles around RPA focus on so-called low hanging fruits, which means that cases reviewed are in favor of RPA. There seems to be a little bit void to cases such as this, where transaction numbers appear low. The discipline of Project Management does not seem to lean toward RPA if we consider it isolated and make only superficial study of its processes, because the number of possible transactions does not look large enough. At least in the Company, many individual processes and tasks found seem to be small and have a relatively small number of transactions, are done only once per month or project, or are done only by few people. These are not factors that would speak on behalf of RPA in case of project management, in general.

In discussions and the interviews, people have indicated many possibilities that they think could be automated and transferred to RPA in Project Management. Further examination and considerations have revealed that, what people have thought about, does not belong to project management, but belongs to project deliverables or other documents produced within a project. It is a small but significant difference when we consider only Project Management as a scope.

The Company has already used RPA successfully in operative projects to handle project documentation, such as inputs given by a customer. If we think about the information received from interviews and discussions, there are many other similar cases just waiting to be automized successfully. Some of the cases would probably fall on to the category of low hanging fruits.

However, for Project Management, it might not be easy to find a single case that would have such a good prospect with RPA, on its own, that it would be easy to decide whether to invest in RPA, even when the actual robot would not cost anything. The side costs that come from infrastructure for the robot may still be quite high if RPA would be considered to have official company support.

Nonetheless, there are also a couple of other cases to be argued here. The first case is when there are already made investments to RPA. In such a case, we can consider the actual costs of implementing RPA reduced. However, there are still some costs that should be included with the ROI calculations, like training and increased licenses. The rest of the costs can be ignored, as long as they are not caused by this new case, because they are already considered in previous cases. As an example, the case that RPA was invested in might only use 40% of the actual capacity of the RPA agent. There is still plenty of capacity to use for other work. When used, if capacity is at the threshold, prioritization can and should be used before investing for a new robot.

The second argument is the development of the first. Even though there might not be one single case that justifies RPA on its own, there could be several, that when considered together, are enough, because the number of transactions will be higher. Collective benefits of several processes and tasks, even unrelated to each other, may rise clearly above the investment threshold. In such a case, RPA would justifiable for Project Management, even on its own.

The example robot case demonstrated clearly that RPA can be used, for example, transferring data to reports and that it does that significantly faster than a person would. What is not clear is that if that would be enough for automation, probably not, if only monetary benefits are considered. If we would include other tasks and processes, such as initializing projects in the systems, creating all required project management documents and implementing project scheduling assistant for milestones, it could change the view and would probably be good enough for automation with RPA. This example is specific for the company and would be different for other companies. Each would need to find their own solution to be considered.

Above mentioned arguments are all considering cost as the main driving force for investment. Another perspective is not a cost-based in the sense that it is hard to give value for how a person is feeling better at the job because there is less frustrating and mundane tasks to be done. It can be argued that if a person can focus on tasks that matter more instead of doing frustrating tasks, that person feels happier and performs better. There is value on that too, but not so easily defined.

6.4 Benefits and costs of RPA for Project Management

We discussed shortly about the benefits of RPA in Chapter 2.2. It was established that evaluating ROI would be a good way to evaluate if investments to RPA should be made. On the other side of the equation, we had costs, and on the other side, we had benefits. The benefits established in that chapter were abstract terms in a sense that ‘Improved efficiency’ is not tangible and cannot be directly measured, but requires some understanding of what current situation is and what is going to change because of RPA.

The example robot case gives us some perspective on the matter of benefits in terms of efficiency against a specific type of task done by a human. We got a value for the ‘transaction’ speed of a robot when it was working with excel data. Test data indicated that the robot is roughly 20 times faster than a human in a simple data, read and write type of transaction tasks with excel. A robot can be even faster than that, given that the programming is done by some with a better understanding of how to do it properly.

Appendix 5 is a calculation template created as an attempt to evaluate if any task or process has the potential to be automated with RPA. It is a concept which tries to make the evaluation of a process or multiple processes more straightforward and faster. It is based on the ROI concept and has its fields for both cost and benefits. The calculation shown in the template is partly based on the test case. Other than that, mots of other values used in the calculation are randomly selected and serve no other purpose except to explain the template.

The first part of the template, current process, is used to add steps of the evaluated process that would be automated. Only steps that are done with computers are added. One should consider how detailed steps are used here. The error margin of the cost / added value of the process will decrease as more detailed steps are added. Caveat is that the evaluation takes longer.

Steps that are similar to each other can be combined and added only as one line. In the calculation, ‘open file’ is one example of such a step. Two different files are opened at a different time but are similar to each other that they can be treated as same. For each step, the number of times it is done in one process cycle is added along with speed, how much time it takes, in seconds, to do the step. Some example speeds are listed below steps. Total time is calculated at the end of each row. New rows can be inserted above text (add more rows above). Several individual processes can be added either by adding all steps to new rows or including all similar steps in the amount of already added steps.

Below process steps, template calculates the total number of transactions as well as the total time of one process cycle. Time for each step was added in seconds, but total time is converted to hours, minutes and seconds.

The assumption with the template is that each step that is transferred to RPA is either a reduced cost or added value of an equal amount than it costs to be done by a person. Therefore, the template calculates the total monthly cost of the activity by multiplying total time with the number of people doing the process and how many times it is done in a month, with the average hourly cost of the persons involved. Resulting cost is directly transferred into the benefits of the robot process.

The following section, benefits of the robot process, is collecting all foreseen benefits of the automatization and summarizing them to a total monetary value. In this section, more rows can be added if necessary. Two existing rows, visible in the template, are default items, which are not meant to be removed. The first row refers to the value of the total cost of the activity and is automatically updated. The second row calculates the benefits of improved quality. The robot test indicated that error frequency is 1,9 errors per 100 actions. This value has been used in the template. The formula in the value cell uses the total amount of actions, error frequency and estimated cost per error and will give the amount of savings if the process is done by a robot. The cost of error may not be easy to determine, and if given too high, it can twist the result of the template in favor of RPA without proper merit. Proper consideration is needed here.

The next section, recurring costs of the robot process, is used to add repeating cost of automation process for a month. Some of such costs have been shown in the calculation as an example. Cost added here should be something that occurs because a robot is in place. A robot might have a monthly or annual paid license fee. There may be a maintenance service that has been bought from a robot vendor or some other company. Servers used for automation may have fees that would be included here. These costs may be considered full costs that belong only to the evaluated process. They can also be split between the evaluated process and already existing and previously evaluated processes.

The blue line in the template deducts costs from benefits and gives the monetary balance of the costs and benefits. Positive value means that automating the process is beneficial with the values used in the evaluation. The value is given in euros and is a monthly cost or gain.

Sometimes business decisions are made based on how long it takes to cover all initial costs of the investment. Therefore, an additional section, implementation costs, has been added to the template. Here can be added all known and foreseen costs that are not recurring, but are caused by automating the evaluated process. Costs added here can be split similarly as recurring costs if necessary. The final row will estimate, in years, how long it takes before gains from the evaluated process will surpass the implementation costs.

The calculation template is a tool to help evaluate the robot automation case. It uses monetary values and, in case of quality, tries to guide the user to evaluate the monetary value of not making any mistakes in the process. It has been mentioned before in this study that other benefits of the automation exist, such as improved wellbeing. However, it might not be easy to give any value for those benefits. Nonetheless, those benefits might prove worthwhile to consider.

There is one noteworthy matter that the template does not consider. The effective running time of a robot can be 24 hours each day, including weekends. From the test robot case, we know that this specific single case took only two minutes to run and thus does not spend robot resources at all. Total running time and running time of a single process should always be considered when altering or adding processes to the pool. At some point, another robot or several robots are needed, which will change the costs, and re-evaluation may be necessary. There is also an area where prioritizing processes may be an option before a new robot, and that should also be considered.

6.5 Future of RPA

The future of RPA can be reviewed from many different angles. Economic point of view would include concepts like market growth, risk in investment success, maturity and other points that would be related to how the technology will progress as business and revenue builder. Current forecasts predict that the market is growing fast in the next few years. In some predictions, global revenue will grow from four billion U.S dollars to ten billion by 2023. (Statista 2020)

Another technological point of view would consider where RPA is now and where it would technologically set itself in the future. Technologically RPA is already in a sound place, and it has been proven to work in heavy IT businesses. The base of the technology has matured years, and it is now collected and utilized in a more refined way in a single application. It is easy to predict that the applications and use of RPA will continue to evolve and what we have today will possibly be quite something else in five years.

AI is another very intriguing path of development for RPA. Currently, the majority of applications do not utilize AI at all. When we talk about AI, we are talking about a system that is capable of self-learning within its programmed frame and decision making that appears to be cognitive. With AI, potential applications of RPA will increase considerably.

In general, we have a good understanding of how and where to use this technology on specific businesses that greatly benefit from it. However, it is not so clear on how to implement this technology on industries and businesses whose core business or processes do not involve heavy use of IT systems. Such cases could be found in small and medium-sized businesses where the benefits are not easily seen before implementation. Furthermore, the cost of poor implementation will eat out the potential benefits, and it is considered failure before it has even started properly. This matter has not been touched in any of the articles reviewed for this study. There seems to be unrevealed potential and market for the technology if it can be implemented more efficiently and with increased success.

REFERENCES

Aquirre, S. and Rodriquez, A. 2017. Automation of a Business Process Using Robotic Process Automation (RPA): A Case Study. Applied Computer Sciences in Engineering, Aug 1, 2017. Available from: https://www.researchgate.net/publication/319343356_Automation_of_a_Business_Process_Using_Robotic_Process_Automation_RPA_A_Case_Study.

Anagnoste, S 2018. Setting up a Robotic Process Automation Center of excellence. Management Dynamics in The Knowledge Economy, Vol 6, pp.307-322.

Alberth, M. & Mattern, M. 2017. Understanding robotic process automation (RPA). Journal of Financial Transformation, Capco Institute, vol. 46, pp. 54-61. Available from: https://www.capco.com/Capco-Institute/Journal-46-Automation.

Barkin, I. 2016. What is RPA? A Guide to Robotic Process Automation. Referenced Sep 9, 2018. Available from: http://blog.symphonyhq.com/what-is-rpa.

Dinsmore, P.C. and Cabanis-Brewin, J. 2014. The AMA Handbook of Project Management. Fourth edition. Amacom Books.

Gadre, A., Jessel, B. and Gulati, K. 2017. Rethinking Robotics? Take a step back. Journal of Financial Transformation, Capco Institute vol. 46, pp. 34-45. Available from: https://www.capco.com/Capco-Institute/Journal-46-Automation.

Galusha, B. 2018. Considering RPA? Ask Smart Questions for Long-Term Success. Journal of Database Trends and Applications, p 44-45.

Hart, C., 1999. Doing a Literature Review. 1st edition. SAGE Publications.

Heinzl, A., Bichler, M. and Aalst, Wil M. P. van der 2018. Robotic Process Automation. Business & Information Systems Engineering, Issue 4, pp. 269-272. Available from: https://doi.org/10.1007/s12599-018-0542-4.

IRPA AI 2018. Understanding RPA ROI - How to measure it and why it's important. www.irpaai.com: Institute for robotic process automation & artificial intelligence. Referenced Aug 6, 2018. Available from: https://irpaai.com/wp-content/uploads/2018/12/Understanding-RPA-ROI-HelpSystems.pdf

Jaynes, H. & Livingstone, L. 2015. Introduction to robotic process automation - A Primer. Referenced Aug 6, 2018. Available from: https://irpaai.com/wp-content/uploads/2015/05/Robotic-Process-Automation-June2015.pdf

Kapulukira, C. 2019. The Business Value of Robotic Process Automation: a Structured Literature Review. Hasselt University.

Kerzner, H 2015. Project management metrics, KPIs and dashboards. International Institute for Learning, Inc.

Kirchmer, M. 2017. Robotic Process Automation – Pragmatic Solution or Dangerous Illusion? Referenced Aug 6, 2018. Available from: http://insights.btoes.com/risks-robotic-process-automation-pragmatic-solution-or-dangerous-illusion.

Lacity, M. and Willcocks, L. 2016. A New Approach to Automating Services. MITSloan, Fall 2016 Issue. Available from: http://mitsmr.com/2cUzK69.

Lacity, M., Willcocks, L. and Craig, A. 2017. Automation - Robotizing Global Financial Shared Services at Royal DSM. Journal of Financial Transformation, Capco Institute, vol. 46, pp. 62-75. Available from: http://www.capco.com/Capco-Institute/Journal-46-Automation.

Le Clair, G., O'Donnel, G., McKeon-White, W. and Lynch, D. 2018. The Forrester Wave: Robotic Process Automation, Q2 2018.

Le Clair, G., O'Donnel, G., Lipson, A. and Lynch, D. 2019. The Forrester Wave: Robotic Process Automation, Q4 2019.

Lowes, P. 2016. An Introduction to Robotic Process Automation. Referenced Aug 6, 2018. Available from: https://deloitte.wsj.com/cio/2016/03/13/an-introduction-to-robotic-process-automation/.

Madakam, S., Holmukhe, R.M. and Jaiswal, D.K. 2019. The Future Digital Work Force: Robotic Process Automation (RPA). Journal of Information Systems and Technology Management, vol. 16. Available from: http://dx.doi.org/10.4301/s1807-1775201916001.

Ostdick, N. 2016a. The Evolution of Robotic Process Automation (RPA): Past, Present, and Future. Referenced Aug 6, 2018. Available from: https://www.uipath.com/blog/the-evolution-of-rpa-past-present-and-future.

Ostdick, N. 2016b. Looking Forward, Looking Back: Five Key Moments in The History of RPA. Referenced Aug 6, 2018. Available from: https://www.uipath.com/blog/looking-forward-looking-back-five-key-moments-in-the-history-of-rpa.

PMBOK GUIDE, 2013. Project management body of knowledge. Fifth edition. Project Management Institute.

Rivera, A. and Kashiwagi, J. 2016. Identifying the State of the Project Management Profession. Procedia Engineering, vol. 145, pp. 1386-1393. Available from: https://doi.org/10.1016/j.proeng.2016.04.204.

Statista 2020. Robotic process automation (RPA) market revenues worldwide from 2017 to 2023. Referenced May 9, 2020. Available from: https://www.statista.com/statistics/740440/worldwide-robotic-process-automation-market-size/

Taylor, S.J., Bogdan, R. and Devault, M.L. 2015. Introduction to Qualitative Research Methods: A guidebook and Resource. 4th edition. John Wiley & Sons, Incorporated.

The Company 2019. Operational Handbook. Referenced Oct 8, 2019.

UiPath Studio Software, version 2019.10.4

Interview guides and support questions

To conduct the interviews, following set of supporting guidelines and questions were used to keep the interview going into right direction.

- Objective is to find at least one thing that could be automated and transferred to robot
- Focus on project management
- Focus on tasks that are done with computer

Categories

- Reporting
    - Initializing, creation
    - Filling
    - Collecting data

- Data manipulation
    - What kind of manipulation is done to data?
    - Is it collected from somewhere, how?
    - Are documents being created? How many?
    - Is data moved from one place to another?
        - One place to one place?
        - One place to many places?
        - Many places to one place?
        - Many places to many places?
    - Is data being changed in the middle of transfer in some way?
        - Added to each other?
        - Subtracted from each other?

- File handling
    - What kind of files?
    - What is being done with the files?
    - Opened, closed, copied?

- Polarion?
    - What does it do?
    - Is data being transferred?
    - What kind of projects are in question?
    - How would this involve project management?

Survey for work and tasks in operative projects

Hi,
You have been invited to answer this survey, because, in your current or previous role, you have been working as a project manager or as a member in a project team or you have an understanding of what is being done in operative projects.

The purpose of this survey is to gather data for the master's thesis that I'm currently doing for Project Management.
I hope you will have some time to answer the following questions as all data gathered, will help me to finish my work.

Sincerely,

Jan Kiilunen

1. Estimate, on average, how many hours would you work with a computer in a week? *

Assume, you would work 100% of your week for an operative project.

- ◯ 0 - 8 hours
- ◯ 8 - 16 hours
- ◯ 16 - 24 hours
- ◯ 24 - 32 hours
- ◯ 32 - 40 hours

2. What are the most time consuming work or task types you need to do? *
Consider the work you do with the computer for operative projects.
You can also select other types and give your own category.

- [ ] Using design software.
- [ ] Attending online meetings.
- [ ] Talking or chatting with other people. (Skype or similar)
- [ ] Managing files. (moving, copying, storing project files)
- [ ] Initializing and creating reports.
- [ ] Managing data. (Collecting, transferring and manipulating)
- [ ] Reading and Writing email.
- [ ] Other category 1 ______
- [ ] Other category 2 ______
- [ ] Other category 3 ______

3. Estimate how many hours, on average, does a single work or task take in selected categories.

Estimate in half an hours (0.5).
Examples:
When I read and answer emails, it takes, on average, 0.5 hour each time.
Single meeting lasts, on average, 1.5 hours.

Reading and writing email (hours) *

Attending on-line meetings (hours) *

Talking or chatting with other people. (Skype or similar) (hours) *

Using design software. (hours) *

Initializing and creating reports. (hours) *

Managing data. (Collecting, transferring and manipulating data) (hours) *

Managing files. (moving, copying, storing project files) (hours) *

Other category 1 (hours) *

Other category 2 (hours) *

Other category 3 (hours) *

4. Initializing and creating reports *

Describe shortly, in steps, the work or tasks that you have in mind when you selected this category.

5. Managing data *

Describe shortly, in steps, the work or tasks that you have in mind when you selected this category.

6. Managing files *

Describe shortly, in steps, the work or tasks that you have in mind when you selected this category.

7. Other category 1 *

Describe shortly, in steps, the work or tasks that you have in mind when you selected your own category.

8. Other category 2 *

Describe shortly, in steps, the work or tasks that you have in mind when you selected your own category.

9. Other category 3 *

Describe shortly, in steps, the work or tasks that you have in mind when you selected your own category.

10. Select 1 to 3 work or task types that seem useless, unnecessary or menial in the way that they are currently done in operative projects?

Consider tasks that seem useless or pointless because of the results, or create unnecessary amount of manual or other types of work compared to the results, or that they seem menial because of the simplicity, repetitiveness or other reason.

- [ ] Using design software.
- [ ] Attending online meetings.
- [ ] Talking or chatting with other people. (Skype or similar)
- [ ] Managing files. (moving, copying, storing project files)
- [ ] Initializing and creating reports.
- [ ] Managing data. (Collecting, transferring and manipulating)
- [ ] Reading and Writing email.
- [ ] Other category 1 ________
- [ ] Other category 2 ________
- [ ] Other category 3 ________

11. Reading and writing email *

Is the tasks you are thinking the same as in most time-consuming? If the answer is yes, you can leave the current answer.
Otherwise, describe shortly, in steps, the work or tasks that you have in mind when you selected your own category.

Same task as in the previous question.

12. Attending in online meetings *

Is the tasks you are thinking the same as in most time-consuming? If the answer is yes, you can leave the current answer.
Otherwise, describe shortly, in steps, the work or tasks that you have in mind when you selected your own category.

Same task as in the previous question.

13. Talking and chatting with other people. (Skype or similar) *

Is the tasks you are thinking the same as in most time-consuming? If the answer is yes, you can leave the current answer.
Otherwise, describe shortly, in steps, the work or tasks that you have in mind when you selected your own category.

Same task as in the previous question.

14. Using design software *

Is the tasks you are thinking the same as in most time-consuming? If the answer is yes, you can leave the current answer.
Otherwise, describe shortly, in steps, the work or tasks that you have in mind when you selected your own category.

Same task as in the previous question.

15. Initializing and creating reports *

Is the tasks you are thinking the same as in most time-consuming? If the answer is yes, you can leave the current answer.
Otherwise, describe shortly, in steps, the work or tasks that you have in mind when you selected your own category.

Same task as in the previous question.

16. Managing data. (Collecting, transferring and manipulating) *

Is the tasks you are thinking the same as in most time-consuming? If the answer is yes, you can leave the current answer.
Otherwise, describe shortly, in steps, the work or tasks that you have in mind when you selected your own category.

Same task as in the previous question.

17. Managing files. (moving, copying, storing project files) *

Is the tasks you are thinking the same as in most time-consuming? If the answer is yes, you can leave the current answer.
Otherwise, describe shortly, in steps, the work or tasks that you have in mind when you selected your own category.

Same task as in the previous question.

18. Other category 1 *

Is the tasks you are thinking the same as in most time-consuming? If the answer is yes, you can leave the current answer.
Otherwise, describe shortly, in steps, the work or tasks that you have in mind when you selected your first own category.

Same task as in the previous question.

19. Other category 2 *

Is the tasks you are thinking the same as in most time-consuming? If the answer is yes, you can leave the current answer.
Otherwise, describe shortly, in steps, the work or tasks that you have in mind when you selected your second own category.

Same task as in the previous question.

20. Other category 3 *

Is the tasks you are thinking the same as in most time-consuming? If the answer is yes, you can leave the current answer.
Otherwise, describe shortly, in steps, the work or tasks that you have in mind when you selected your third own category.

Same task as in the previous question.

There is a possibility to automate specific sort of work routines and tasks done with computers in operative projects.
Typical tasks that are good candidates for automation are rule-based, repetitive and time-consuming.
Think about the work and tasks you do in operative projects.

21. Describe one or more work routine or task that you think could or should be automated

I don't come up with anything right now.

22. Would you like to tell me some more?

If you think that you might have more to give to my thesis work, I would be pleased to arrange an informal interview where we can discuss in more detail about the routines at operative projects.

In such case, please, leave me your name and email and I will contact you as soon as possible to arrange the interview.

Name

Email

Example robot description and flowcharts

Main Process

Flowcharts are screen shots from UiPath Studio software. Main process flowchart shows mains steps of the robot.

1. First some file action attributes are initialized
2. Logging for the robot test runs are initialized
3. Initial input data excel is read
4. Final report file is checked and initialized if necessary. New report is saved to result folder.
5. Input data is read from the weekly report file and prepared for writing back to final report
6. Final report is written to excel and saved.
7. Log file data is collected and written to logging excel.
8. Process is checking if there is more files to run and loops back to beginning or ends run.

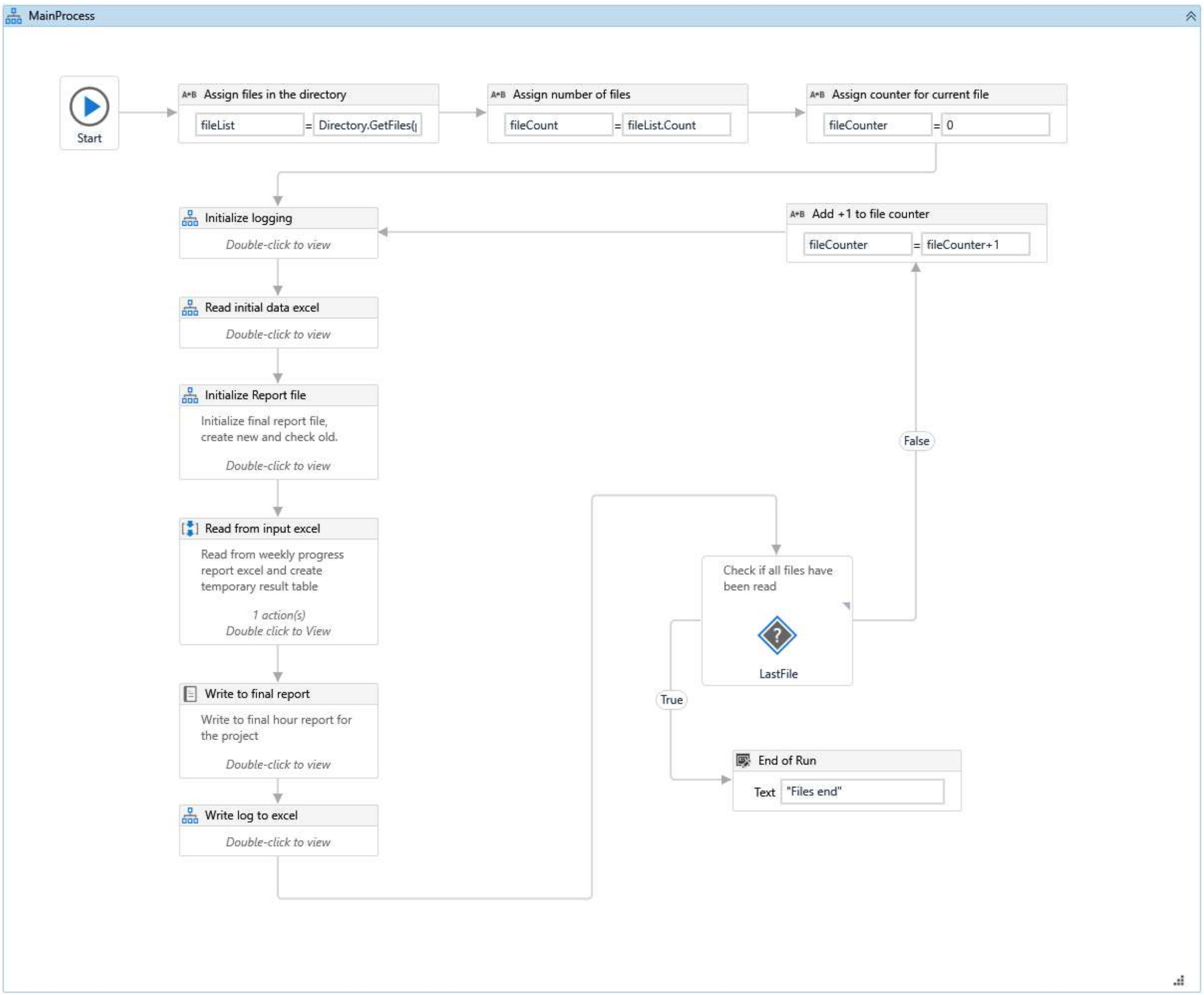


Figure 1. Main process.

Initializing test logging

1. Database is built
2. Start date and start time is added to data table.

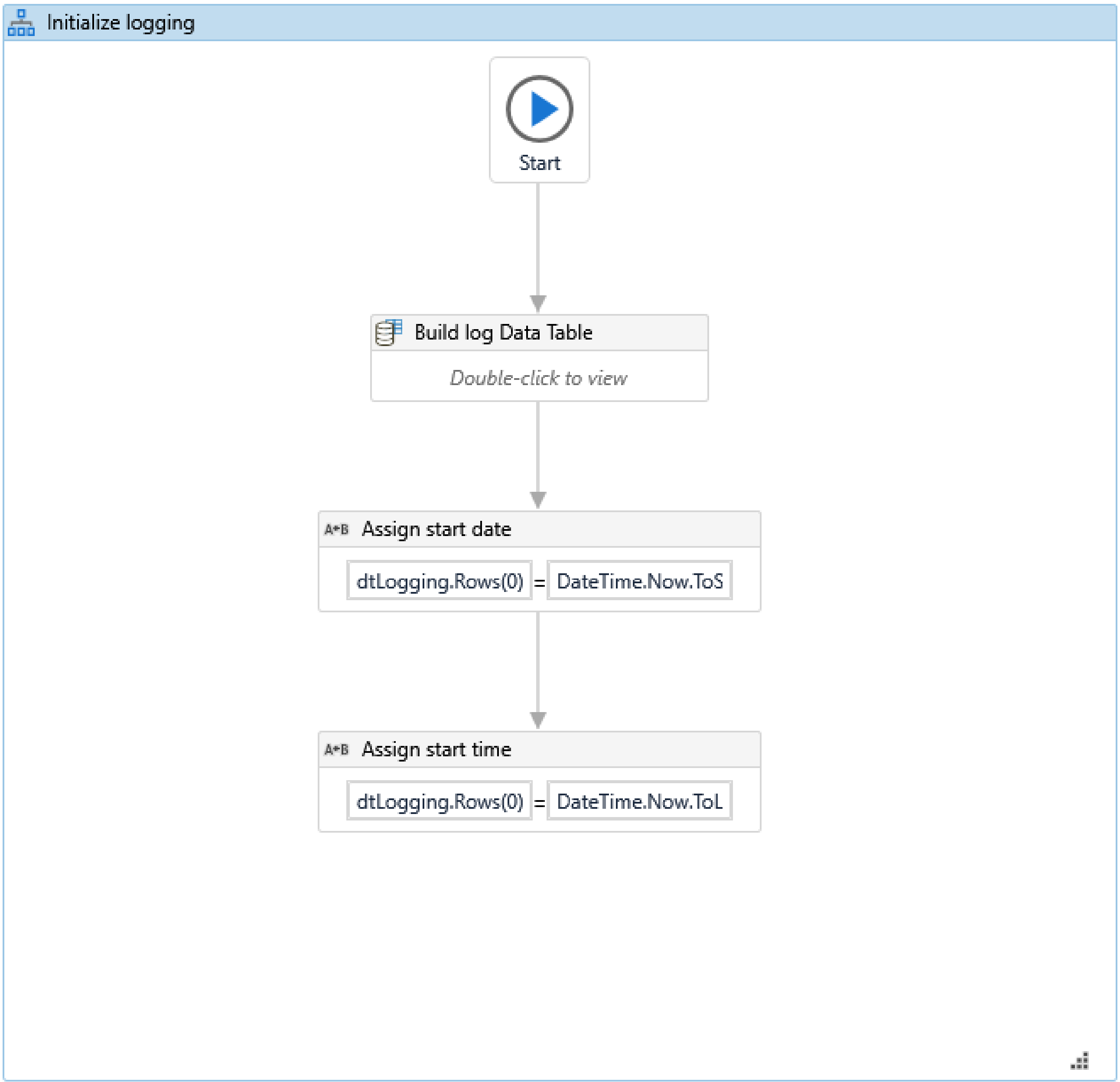


Figure 2. Initializing logging.

Reading initial data and storing information to variables

1. Current file from the ‘fileList’ is read and stored to database
2. Data is stored to variables

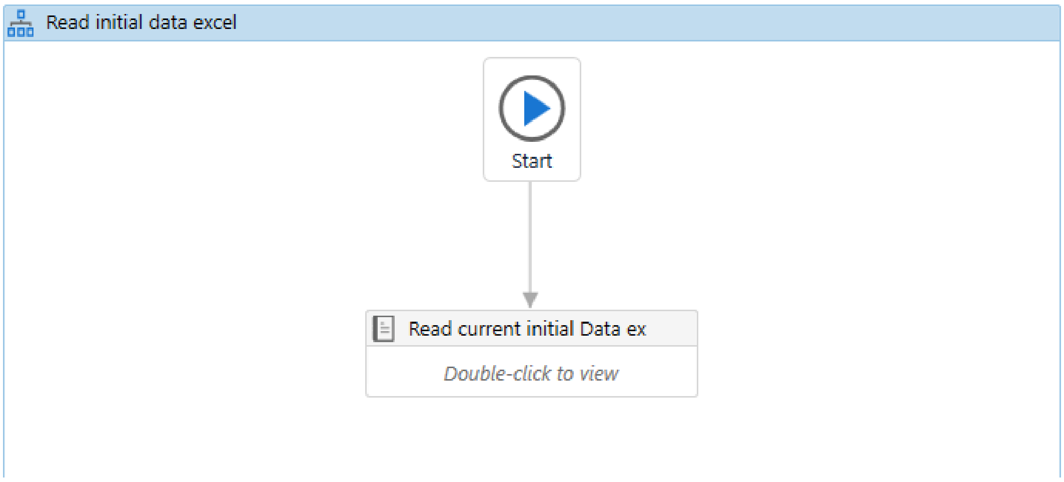


Figure 3. Reading initial data excel.

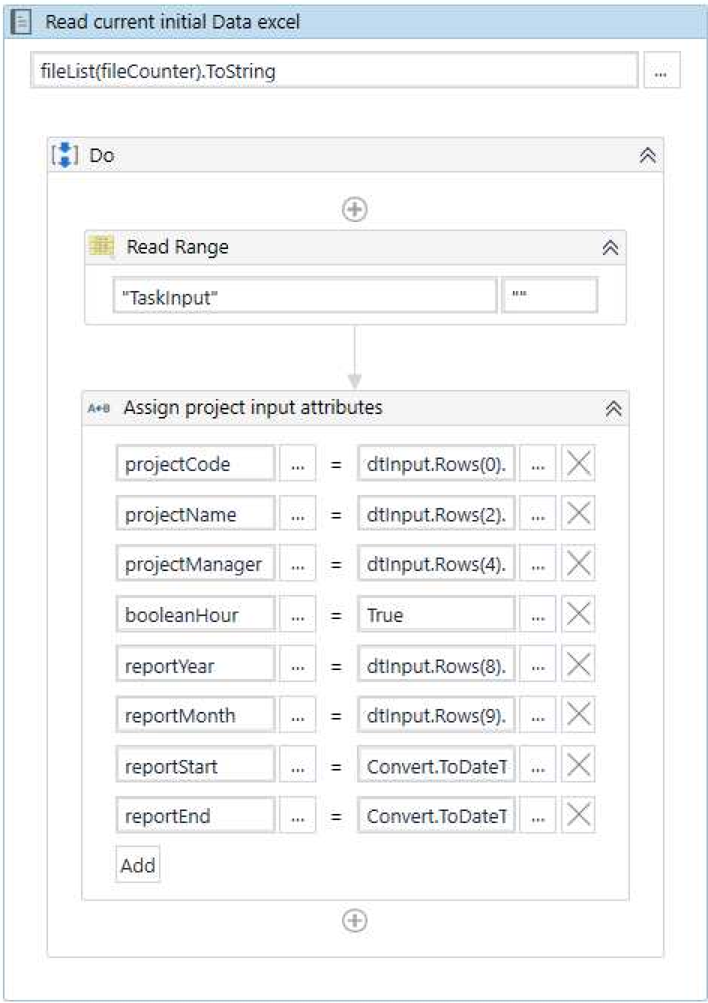


Figure 4. Reading the excel and assigning variables.

Initializing report file

In this step, based on the data read and stored from initial data excel, robot assigns project folder and path and checks if such folder exists.

Robot creates folder if it does not exist and continues to check if hour report is needed. If report is needed, robot continues to check if report already exists in project folder established in the beginning of this step.

If report does not exist, robot copies report template to project folder and renames it according to rules. If new project report was created robot will set 'booleanHourNew' to 'TRUE'.

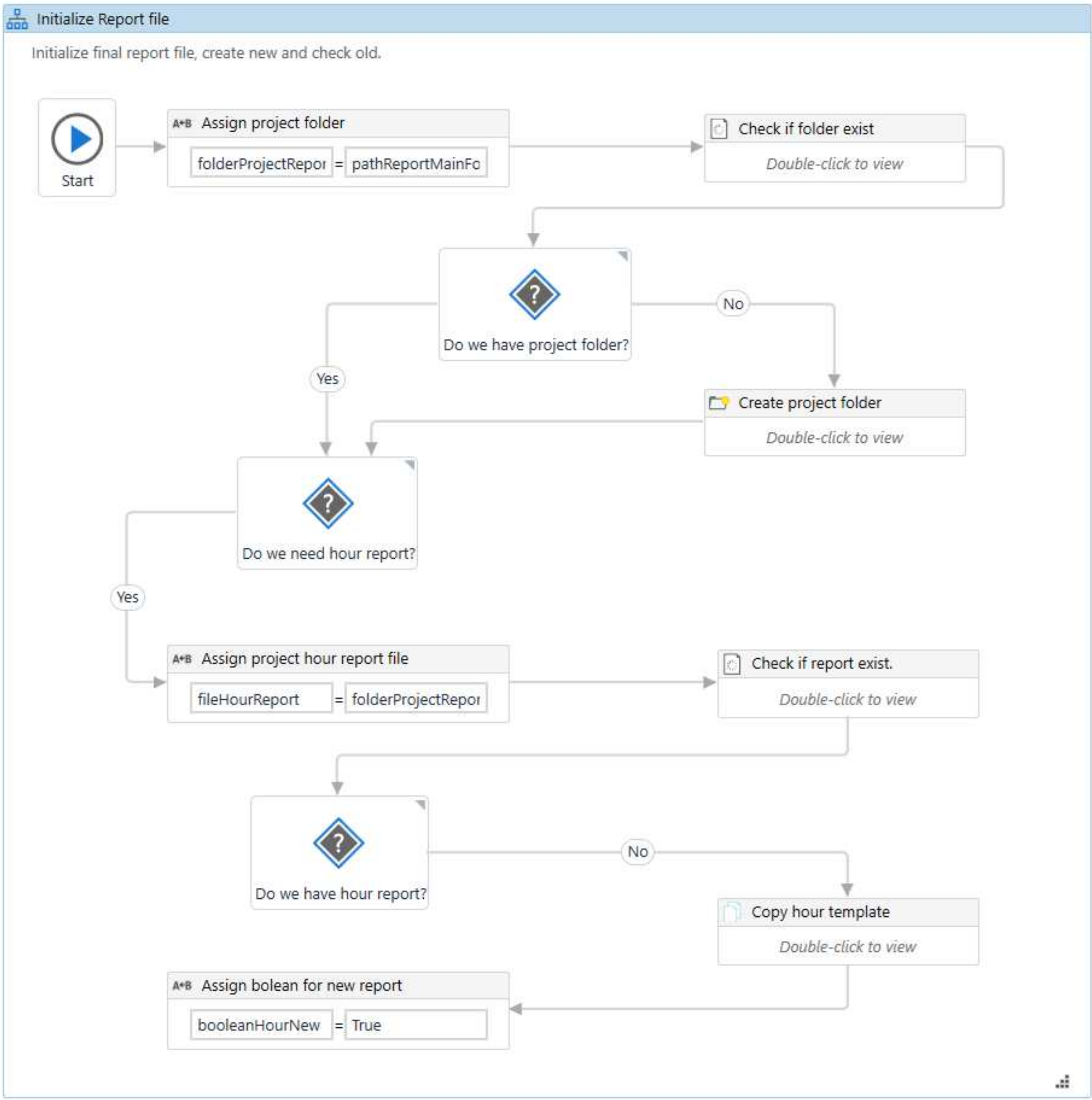


Figure 5. Initializing final report excel.

Read data from input data excel

‘Result data table’ is created first with needed columns for refined data from weekly report. File and path are created from initial data information and assigned to variable. (Weekly report excels have been renamed with same rule used here).

Robot checks if the report exists and assigns Boolean based on the result. Boolean is then checked and run continues if the report did exist.

Report excel is read to ‘temporary data table’ and some helping variables are set for next steps.

‘Temporary data table’ is looped through for each row. Figure 6 shows the flow of that. Resulting data is stored to ‘Result data table’.

GroupTask data table and dictionary became obsolete in latest version of robot, but were used in first versions to help to iterate through the final report excel before writing into it.

‘Result data table’ is sorted and stored into ‘sorted data table’ which then used for writing data back to excel.

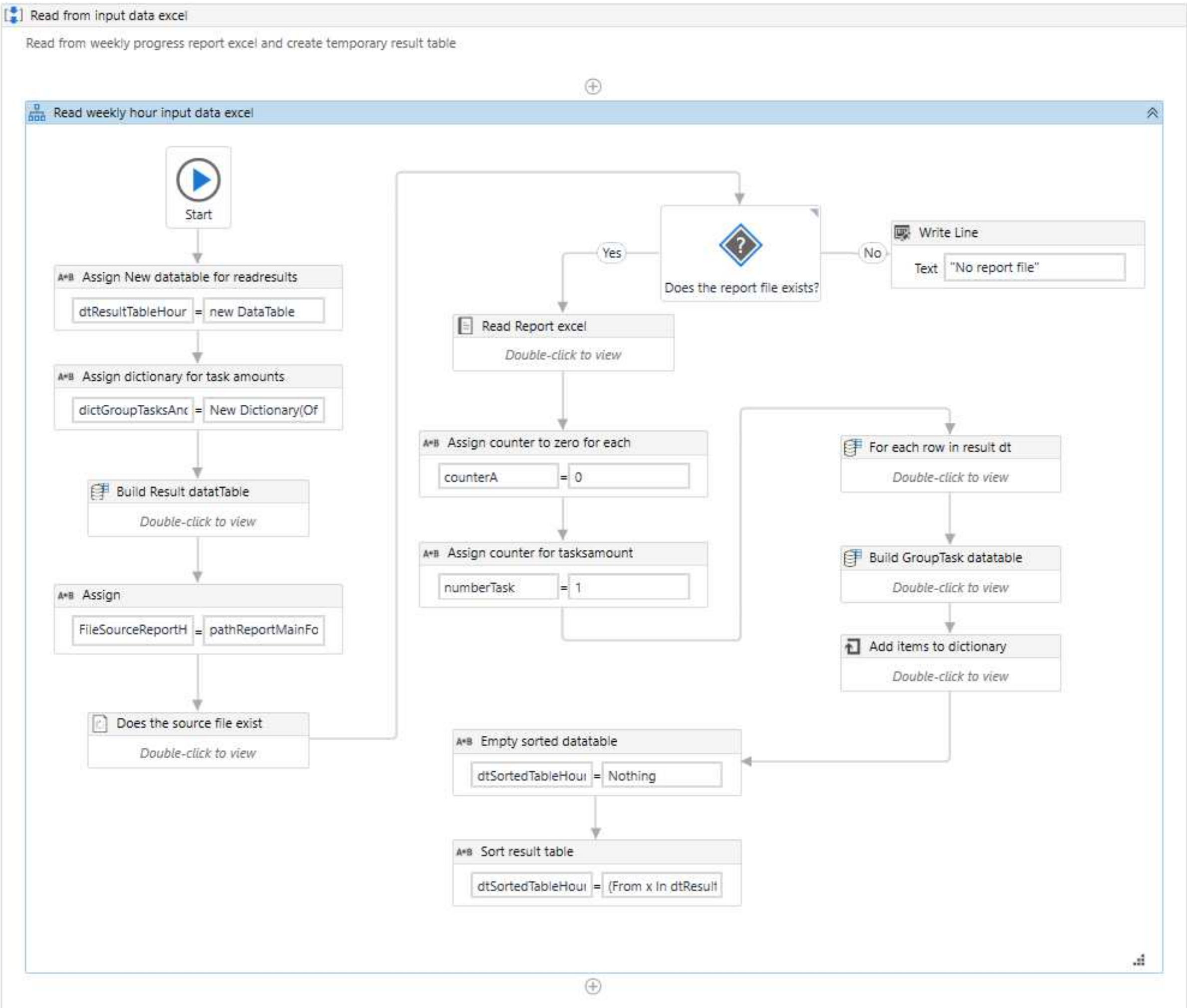


Figure 6. Reading input data ‘Weekly report’ excel.

Looping through ‘temporary data table’

Looping through each row had few reasons. First, data that was to be transferred to the final report was in different rows in the weekly report excel and was not easily usable as it was. Second, for the purpose of sorting the tasks read form the weekly reports, numbers from the task name were extracted and stored in the data table in their respective order.

Figure 8 shows a part of the original weekly report and highlights the data needed. Figure 7 shows the data table structure in ‘result data table’. The “complexity” in the work flow comes from that the number part “1.2.3” was parsed to ‘ColumnNumber1’, ‘ColumnNumber2’ and ‘ColumnNumber3’ in respective order.

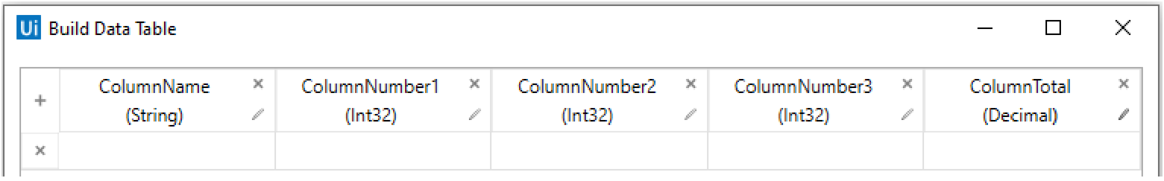


Figure 7. Data structure in ‘Result data table’.

Task Name	Resource Name	WK 14	WK 15	WK 16	WK 17	WK 18	Total
1.1 Management	Person 1	0,0	2,0	0,0	1,5	1,0	4,5
	Person 2	10,0	10,0	11,0	8,0	0,0	39,0
	Total	10,00	12,00	11,00	9,50	1,00	43,5
2.1 Design work	Person 3	0,0	12,0	36,0	50,0	0,0	98,0
	Kiilunen	10,0	15,5	0,0	4,0	4,5	34,0
	Person 4	0,0	0,0	15,0	43,5	10,0	68,5
	Person 5	0,0	0,0	0,0	4,0	0,0	4,0
	Total	10,00	27,50	51,00	101,50	14,50	204,5
2.2 Design work 2	Person 3	35,0	20,0	0,0	0,0	0,0	55,0
	Person 5	3,0	21,5	28,0	0,0	0,0	52,5
	Total	38,00	41,50	28,00	0,00	0,00	107,5

Figure 8. Data structure in ‘Weekly report’ excel.

Writing data to final report

Writing data to final report was rather complicated process. Many helping variables were created and used to loop and check conditions. In the final runs, there were still some errors in the logic of this phase, which remained unresolved.

In the simplest the logic in this step was to read the existing report into 'tempHourDataTable' and use that to quid the writing of data directly into excel. This logic relies in two counters, one for the excel and second for the 'SortedDataTable'.

Run begins with checking if the last month in the excel is a proper month, proper month is either same month that needs to be written or previous month. Based on this check, month column is set. (Or if it was new report made from template, it will set the month column to first month in the report.)

If the last column was previous month, new column is added. Year and month are written to the final excel. Figure 10 shows mostly this part of the work flow.

After setting up proper month column, looping through data is started. Several checks are made in each row for the written excel based on several conditions. Figure 11 shows most of this part of the work flow.

Conditions checked during each row are:

- If the taskGroup has changed. Task name 1.1 has changed to 2.1, for example
- If the current working cell is taskGroupCell.
- If the current row is empty
- If the next row is taskGroup row. (My "run error" is probably result of this logic).
- If the task number matches with task number in the excel. For example current task to be written in the 'SortedDataTable' = '1.1' and current row in the excel has that same number part.
- If the list1(index) value is bigger than list2(index) value.
  - Task number (1.1) from task name in 'SortedDatatable' was split by '.' into numbers and the resulting number was added into list array.
  - Same was done to task number in excel for the current row
  - There's 4 indexes and each index were compared to each other.
  - If list1(index) < list2(index) was true, run continued with adding a row and writing data
  - If all comparison were false, run continued with next row in the excel and same comparison was repeated until result was true.
- When 'SortedDataTable' rowindex was the last one, run was broken and continued in next step.
- After each column or row addition, excel was re-read to 'TempHourDataTable'.

After each written data row, both the 'currentExcelDataRow' counter and 'CurrentSortedDataCounter' was added by one to go forward into next row.

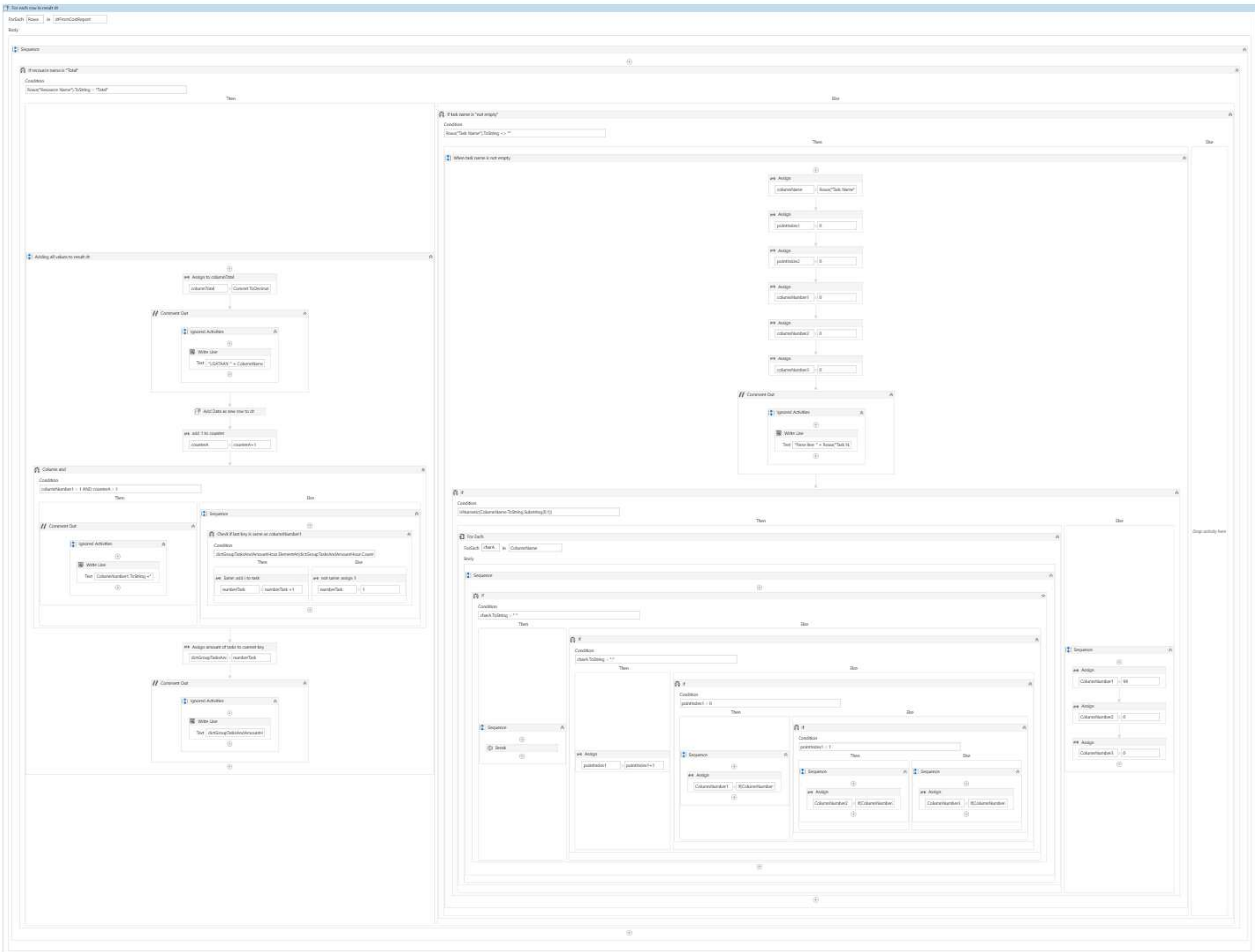


Figure 9. Looping through each row of 'temporary data table'.

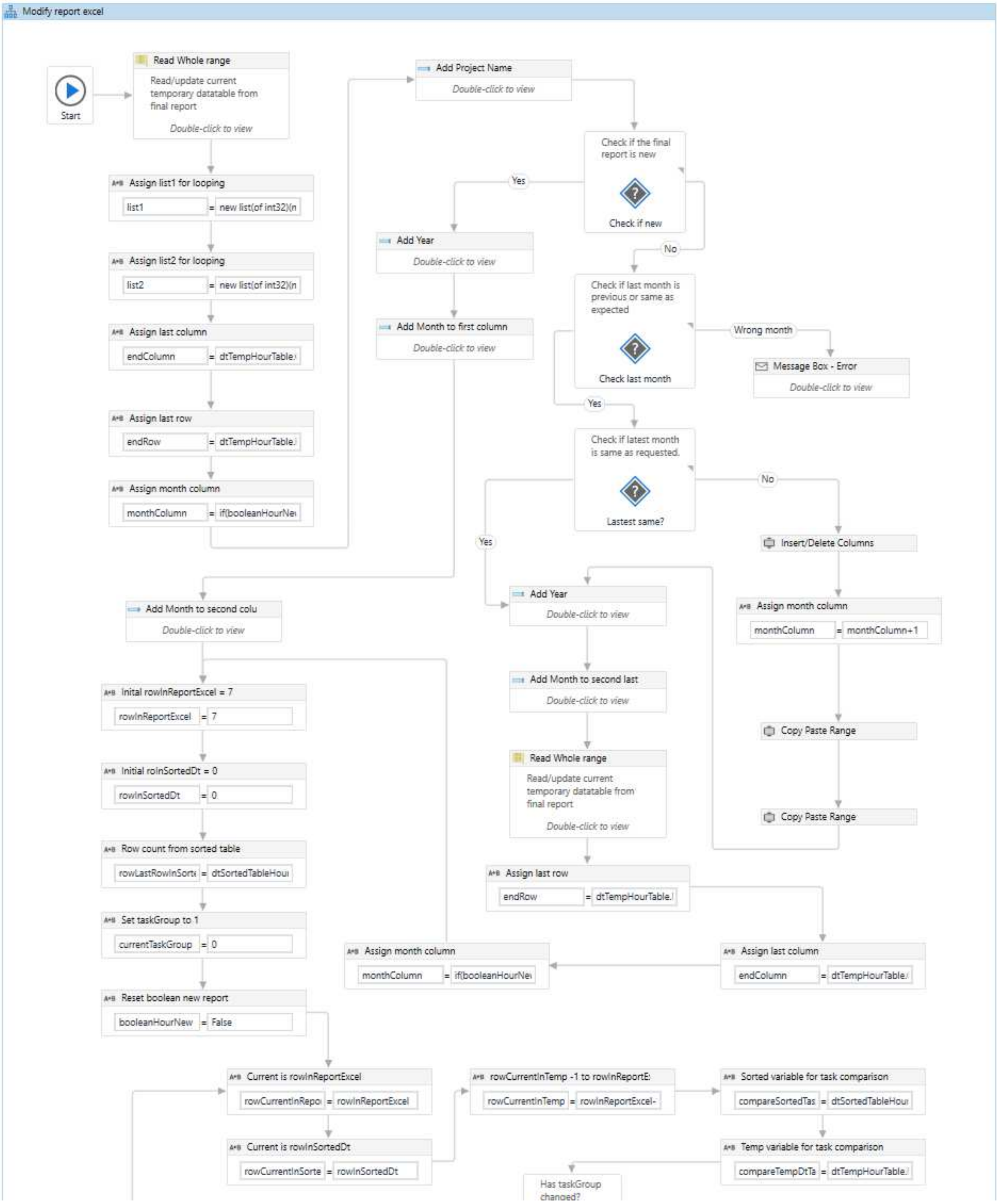


Figure 10. First part of the write data work flow.

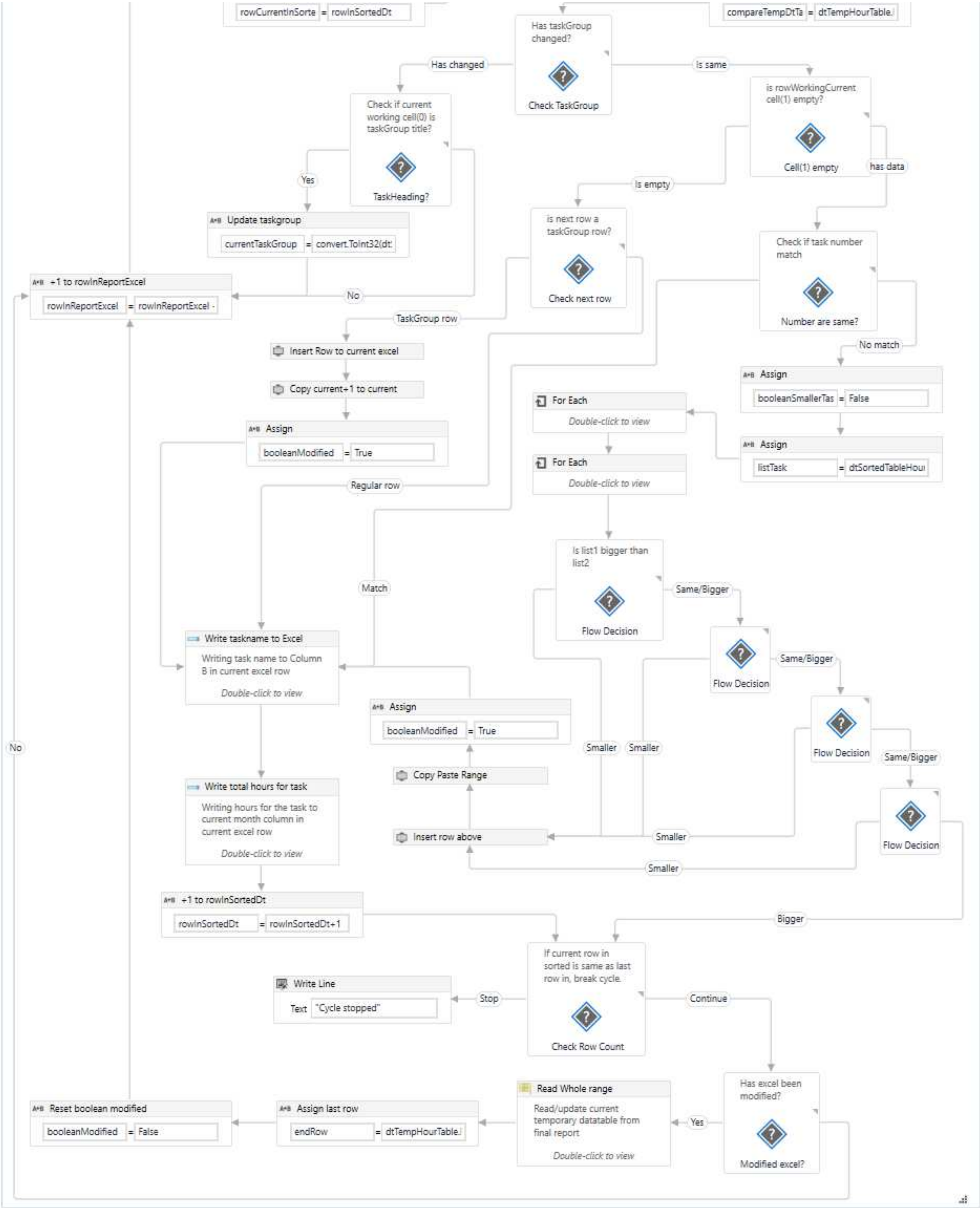


Figure 11. Second part of the write data work flow.

Writing run statistics to logging excel

Data from the run was added to variables. Figure 12 shows all data stored within each run.

Robot run ends after this if current input file was last in the list.

RUN DATE	START TIME	END TIME	LENGHT	PROJECT NAME	YEAR	MONTH	START DATE	NUMBER OF TASKS
17.4.2020	22:22:05	22:22:50	00:46	Example project 1	2018	May	1.5.2018	116
17.4.2020	22:22:51	22:23:19	00:29	Example project 1	2018	June	1.6.2018	114
17.4.2020	22:30:29	22:30:35	00:07	Example project 2	2018	November	1.11.2018	7

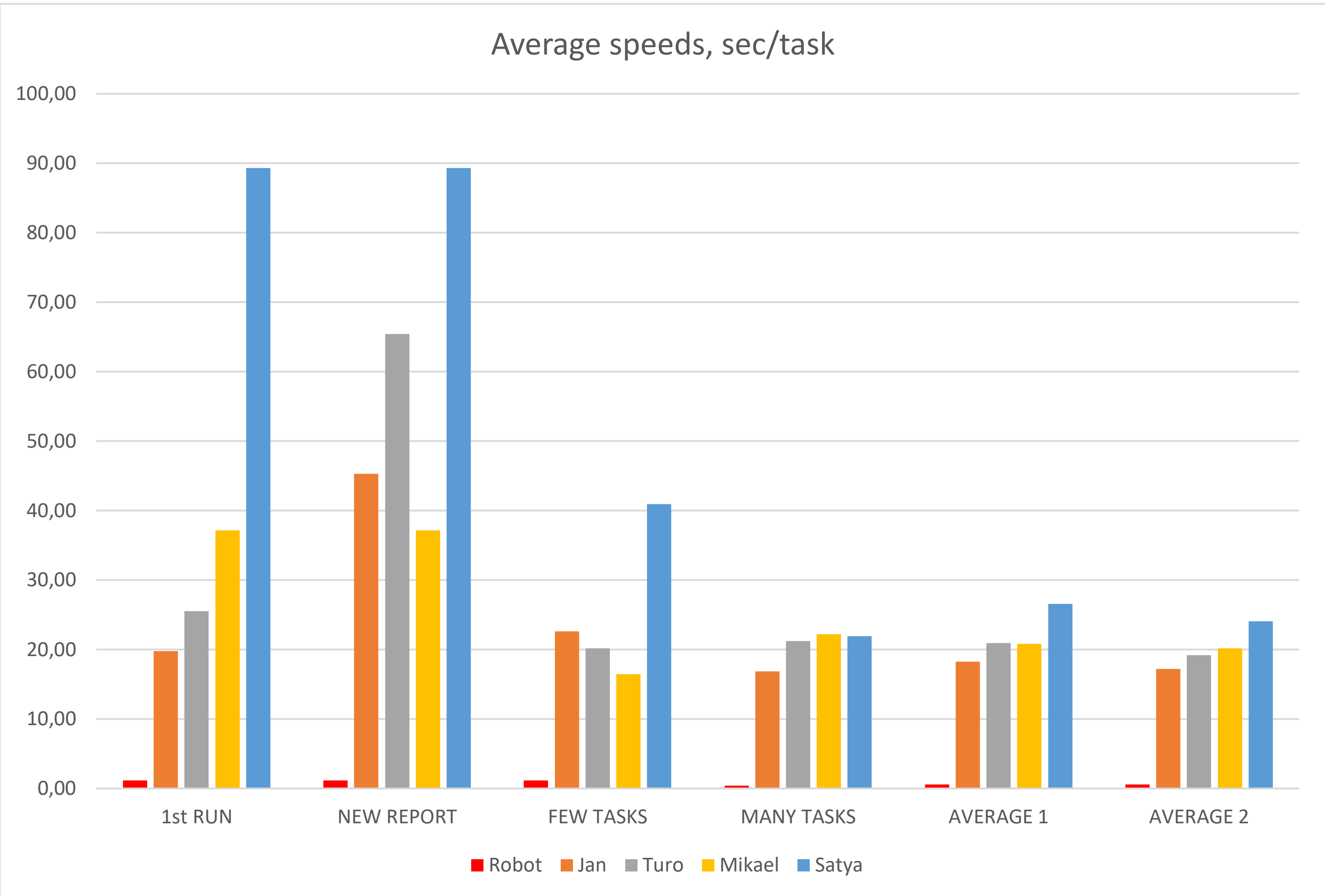
Figure 12. Example of logged information from each run.

Figure 13. Workflow to write logging data to excel.

REFINED RESULTS OF THE ROBOT TEST AND MANUAL COMPARING GROUP TEST

PERSON	TOTAL TIME	AVERAGE SPEEDS, seconds/task						ERRORS	
		1st RUN	NEW REPORT	FEW TASKS	MANY TASKS	AVERAGE 1	AVERAGE 2	Total	# / 100 tasks
Robot	01:49	1,14	1,14	1,16	0,41	0,59	0,57	0	0
Jan	56:16	19,8	45,3	22,6	16,9	18,2	17,2	3	1,6
Turo	1:04:37	25,5	65,4	20,2	21,2	21,0	19,2	6	3,2
Mikael	1:04:08	37,1	37,1	16,4	22,2	20,8	20,2	4	2,2
Satya	1:21:53	89,3	89,3	41,0	21,9	26,6	24,1	3	1,6
AVERAGE		42,9	59,3	25,1	20,5	21,6	20,2	4,0	2,2
MEDIAN		31,3	55,4	21,4	21,6	20,9	19,7	3,5	1,9

1st RUN is the average speed/task of persons first month. Both Satya and Mikael started also with new report
NEW REPORT is the average speed/task for the 'Example Projext 2' first month when the project is created from template
FEW TASKS is the average speed of Example Project 2, all months included
MANY TASKS is the average speed/task for Example Projects 1 and 3 both included
AVERAGE 1 includes all tasks
AVERAGE 2 does not include the slowest run



LOGGED DATA FROM THE MANUAL COMPARING GROUP TEST

TEST PERSON	RUN DATE	START TIME	END TIME	LENGHT	PROJECT NAME	YEAR	MONTH	START DATE	NUMBER OF TASKS	ADDED LINES	SECONDS / TASK	TASKS / SECOND	ERRORS FOUND	ERROR %
Jan	19.4.2020	11:57:30	12:19:34	22:04	Example project 1	2018	September	1.9.2018	67	5	19,8	0,01	2	3,0
Jan	19.4.2020	12:51:00	12:56:17	05:17	Example project 2	2018	November	1.11.2018	7	7	45,3	0,14	0	
Jan	19.4.2020	12:56:57	12:59:50	02:53	Example project 2	2018	December	1.12.2018	7	1	24,7	0,14	0	
Jan	19.4.2020	12:59:51	13:02:36	02:45	Example project 2	2019	January	1.1.2019	8	1	20,6	0,13	0	
Jan	19.4.2020	13:02:38	13:04:31	01:52	Example project 2	2019	February	1.2.2019	6	0	18,7	0,17	0	
Jan	19.4.2020	13:04:32	13:06:39	02:06	Example project 2	2019	March	1.3.2019	8	0	15,8	0,13	0	
Jan	19.4.2020	13:06:40	13:08:43	02:03	Example project 2	2019	April	1.4.2019	9	1	13,7	0,11	0	
Jan	19.4.2020	12:31:29	12:48:45	17:15	Example project 3	2019	July	1.7.2019	73	10	14,2	0,01	1	1,4
Turo	18.4.2020	19:37:33	20:06:05	28:31	Example project 1	2018	September	1.9.2018	67	5	25,5	0,01	4	6,0
Turo	18.4.2020	21:03:01	21:10:39	07:38	Example project 2	2018	November	1.11.2018	7	7	65,4	0,14	0	
Turo	18.4.2020	21:11:36	21:13:46	02:11	Example project 2	2018	December	1.12.2018	7	1	18,7	0,14	0	
Turo	18.4.2020	21:14:09	21:15:51	01:43	Example project 2	2019	January	1.1.2019	8	1	12,9	0,13	0	
Turo	18.4.2020	21:16:34	21:17:32	00:58	Example project 2	2019	February	1.2.2019	6	0	9,7	0,17	0	
Turo	18.4.2020	21:18:04	21:19:14	01:10	Example project 2	2019	March	1.3.2019	8	0	8,8	0,13	0	
Turo	18.4.2020	21:19:56	21:21:26	01:30	Example project 2	2019	April	1.4.2019	9	1	10,0	0,11	0	
Turo	18.4.2020	20:15:51	20:36:48	20:57	Example project 3	2019	July	1.7.2019	73	10	17,2	0,01	2	2,7
Mikael	18.4.2020	15:55:24	16:18:20	22:56	Example project 1	2018	September	1.9.2018	67	5	20,5	0,01	2	3,0
Mikael	18.4.2020	14:50:30	14:54:50	04:20	Example project 2	2018	November	1.11.2018	7	7	37,1	0,14	0	
Mikael	18.4.2020	15:05:23	15:08:24	03:01	Example project 2	2018	December	1.12.2018	7	1	25,9	0,14	1	14,3
Mikael	18.4.2020	15:09:59	15:10:51	00:53	Example project 2	2019	January	1.1.2019	8	1	6,6	0,13	0	
Mikael	18.4.2020	15:11:15	15:12:23	01:08	Example project 2	2019	February	1.2.2019	6	0	11,3	0,17	0	
Mikael	18.4.2020	15:12:55	15:14:20	01:25	Example project 2	2019	March	1.3.2019	8	0	10,6	0,13	0	
Mikael	18.4.2020	15:14:36	15:16:10	01:34	Example project 2	2019	April	1.4.2019	9	1	10,4	0,11	0	
Mikael	18.4.2020	15:18:34	15:47:26	28:52	Example project 3	2019	July	1.7.2019	73	10	23,7	0,01	1	1,4
Satya	18.4.2020	14:08:05	14:32:08	24:03	Example project 1	2018	September	1.9.2018	67	5	21,5	0,01	2	3,0
Satya	21.4.2020	11:47:20	11:57:45	10:25	Example project 2	2018	November	1.11.2018	7	7	89,3	0,14	0	
Satya	18.4.2020	11:57:45	12:04:22	06:37	Example project 2	2018	December	1.12.2018	7	1	56,7	0,14	0	
Satya	18.4.2020	12:05:06	12:09:39	04:33	Example project 2	2019	January	1.1.2019	8	1	34,1	0,13	0	
Satya	18.4.2020	12:10:14	12:13:45	03:31	Example project 2	2019	February	1.2.2019	6	0	35,2	0,17	0	
Satya	18.4.2020	12:19:52	12:22:25	02:33	Example project 2	2019	March	1.3.2019	8	0	19,1	0,13	1	12,5
Satya	18.4.2020	12:23:24	12:26:28	03:04	Example project 2	2019	April	1.4.2019	9	1	20,4	0,11	0	
Satya	18.4.2020	14:45:09	15:12:16	27:07	Example project 3	2019	July	1.7.2019	73	10	22,3	0,01	0	

LOGGED DATA FROM ROBOT TEST RUNS

ROBOT	RUN DATE	START TIME	END TIME	LENGHT	PROJECT NAME	YEAR	MONTH	START DATE	NUMBER OF TASKS	ADDED LINES	SECONDS / TASK	TASKS / SECOND	RUN
Robot	18.4.2020	17:49:26	17:49:34	00:09	Example project 2	2018	November	1.11.2018	7		1,29	0,78	Run 1
Robot	18.4.2020	17:49:34	17:49:41	00:08	Example project 2	2018	December	1.12.2018	7		1,14	0,88	Run 1
Robot	18.4.2020	17:49:41	17:49:48	00:08	Example project 2	2019	January	1.1.2019	8		1,00	1,00	Run 1
Robot	18.4.2020	17:49:48	17:49:56	00:09	Example project 2	2019	February	1.2.2019	6		1,50	0,67	Run 1
Robot	18.4.2020	17:49:57	17:50:14	00:18	Example project 2	2019	March	1.3.2019	8		2,25	0,44	Run 1
Robot	18.4.2020	17:50:14	17:50:31	00:18	Example project 2	2019	April	1.4.2019	9		2,00	0,50	Run 1
Robot	18.4.2020	18:21:22	18:21:45	00:24	Example project 1	2018	September	1.9.2018	67		0,38	2,67	Run 2
Robot	18.4.2020	18:22:32	18:22:54	00:23	Example project 3	2019	July	1.7.2019	73		0,32	3,17	Run 3
Robot	18.4.2020	18:30:56	18:31:04	00:09	Example project 2	2018	November	1.11.2018	7		1,29	0,78	Run 4
Robot	18.4.2020	18:31:05	18:31:11	00:07	Example project 2	2018	December	1.12.2018	7		1,00	1,00	Run 4
Robot	18.4.2020	18:31:12	18:31:19	00:08	Example project 2	2019	January	1.1.2019	8		1,00	1,00	Run 4
Robot	18.4.2020	18:31:19	18:31:24	00:06	Example project 2	2019	February	1.2.2019	6		1,00	1,00	Run 4
Robot	18.4.2020	18:31:25	18:31:31	00:07	Example project 2	2019	March	1.3.2019	8		0,88	1,14	Run 4
Robot	18.4.2020	18:31:31	18:31:38	00:08	Example project 2	2019	April	1.4.2019	9		0,89	1,13	Run 4
Robot	18.4.2020	18:43:37	18:43:59	00:23	Example project 1	2018	September	1.9.2018	67		0,36	2,78	Run 5
Robot	18.4.2020	18:44:00	18:44:20	00:21	Example project 3	2019	July	1.7.2019	73		0,29	3,48	Run 5
Robot	18.4.2020	19:01:24	19:01:30	00:07	Example project 2	2018	November	1.11.2018	7		1,00	1,00	Run 8
Robot	18.4.2020	19:01:30	19:01:36	00:07	Example project 2	2018	December	1.12.2018	7		1,00	1,00	Run 8
Robot	18.4.2020	19:01:38	19:01:44	00:07	Example project 2	2019	January	1.1.2019	8		0,88	1,14	Run 8
Robot	18.4.2020	19:01:45	19:01:51	00:07	Example project 2	2019	February	1.2.2019	6		1,17	0,86	Run 8
Robot	18.4.2020	19:01:53	19:01:59	00:07	Example project 2	2019	March	1.3.2019	8		0,88	1,14	Run 8
Robot	18.4.2020	19:02:00	19:02:06	00:07	Example project 2	2019	April	1.4.2019	9		0,78	1,29	Run 8
Robot	19.4.2020	14:31:33	14:32:17	00:45	Example project 1	2018	September	1.9.2018	67		0,67	1,49	Run 10
Robot	19.4.2020	14:36:25	14:36:59	00:35	Example project 3	2019	July	1.7.2019	73		0,48	2,09	Run 11

	time	tasks	seconds /task
TOTAL TIME	01:49		
1st RUN	00:08	7	1,14
NEW REPORT	00:08	7	1,14
FEW TASKS	00:52	45	1,16
MANY TASKS	00:57	140	0,41
AVERAGE 1	01:49	185	0,59
AVERAGE 2	01:41	178	0,57

Robot values are transferred from robot test logs. Same runs that have been used in manual tests have been transferred.
In the list we have 3 full consecutive runs for the robot.

RPA BENEFIT / COST CALCULATION TEMPLATE

ERROR FREQUENCY 1,9 PER 100 ACTIONS

CURRENT PROCESS

Add process steps into the list. Add how many times step is done in one process cycle.
Evaluate how long it takes to do the step one time, in seconds.

STEP	TYPE	AMOUNT	DESCRIPTION	SPEED	TIME (s)
Open file	Default file action	2	Open two excel files to transfer data	45	90
Save file	Default file action	1	Save one excel file to proper location	30	30
Transfer data	Data transfer	76	Read and copy data from excel to another	20	1520
(add more rows above)					

TOTAL AMOUNT OF ACTIONS	79	
TOTAL TIME OF ACTIONS	0:25:20	
HOW MANY TIME PROCESS IS DONE?	1	MONTH
HOW MANY PEOPLE DO IT?	10	PEOPLE
TOTAL HOURS USED	4,22	IN 1 MONTH
AVERAGE HOURLY COST	60 €	PER HOUR
TOTAL COST OF THE ACTIVITY	253 €	PER MONTH

example list of different action times

ACTION TYPES	SPEED
Default file action	30
Data transfer	20
File creation	60
File transfer	45
Simple data calculation	120

(add more rows above)

BENEFITS OF ROBOT PROCESS	**403 €**	
Reduced costs / added value to customers	253 €	Full cost of the reduced action is added value done directly to customer
Quality benefits	150 €	Reduced amount of errors — 100 € COST PER ERROR *

* average price for one error

RECURRING COSTS OF ROBOT PROCESS	**380 €**	
Licence fees	80 €	Full or partial cost for the process
Maintenance costs	100 €	Full or partial cost for the process
Support	100 €	Monthly cost of support resources
Other monthly fees	100 €	Consultancy etc

(add more rows above)

BENEFIT / COST BALANCE	**23 €**	Positive value means that automating the process is beneficial

IMPLEMENTATION COSTS	**3 150 €**
Consultancy	300 €
Implemantation	250 €
Design	2 000 €
Training	600 €

(add more rows above)

POSITIVE ROI IN	**11**	**YEARS**